15 Do-It-Yourself Projects in This Issue

POPULAR ELECTRONICS

OCTOBER 1957

35 CENTS

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"Economy" Multitester

How To Tape Off the Air

Junior Hi-Fi System

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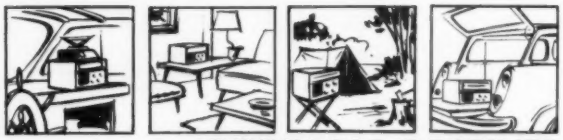
NC-66 is shown with RDF-66 Direction Finder Accessory



PORTABLE RECEIVER

for home and away—indoors and outdoors

NC-66

WORLD'S MOST VERSATILE RECEIVER! . . a ham receiver, a 3-way portable, a marine receiver, and an SWL receiver.

For home and away—indoors and out.

National's new NC-66 offers you AC/DC-battery operation, five-band coverage from 150 kc to 23 mc, electrical bandspread with logging scale, plus a fixed-tuned CW oscillator. Housed in a handsome, rugged metal cabinet with a carrying handle, National quality is evident throughout this great new portable. You'll find it attractively functional with a long "Full-Vue" slide rule dial, a quality 5″ PM speaker, *and* a phone jack. It also has *two* antennas: whip and loop stick.

For boat owners a special marine band from 150 kc to 400 kc covers maritime DF beacon service. And, of course, CD positions are clearly marked.

FEATURES:

- ★ Continuous coverage of DF beacons, AM broadcast, amateur and world-wide shortwave bands. 150-400 kc, .5 to 23 mc.
- ★ Operates on 115 volt AC or DC or self-contained batteries, or 220 volt AC with accessory adaptor.
- ★ Full electrical bandspread.
- ★ Provisions for external direction finder for marine use.
- ★ Salt spray tested.
- ★ Built-in ferrite loop antenna for DF and BC bands.
- ★ Built-in whip antenna for shortwave bands.
- ★ Receives voice or code. Has CW oscillator; and provision for phones.
- ★ "Full-Vue" slide-rule dial with easy-to-read scale. Amateur and principal shortwave bands as well as CD positions clearly marked.
- ★ Logging scale provided.
- ★ Complete with built-in speaker.
- ★ Separate switch for stand-by operation.
- ★ Handsome, modern styling: two-tone metal cabinet, chrome trim, with carrying handle, and enclosed back.

*BAND	COVERAGE
DF	150-400 KC
BC	.50-1.4 MC
1	1.40-4.05 MC
2	4.0-11.4 MC
3	11.0-23 MC

TUNING SYSTEM: Separate general coverage and bandspread tuning capacitors connected in parallel on all bands. Three gang capacitors tune antenna, RF and oscillator circuits. Bandspread knob can be used as a vernier on all frequencies.

AUDIO SYSTEM: Two-stage audio amplifier with 3V4 output tube. Has speaker and phone output jack.

CONTROLS: Main tuning; bandspread; volume control; band selector switch; AM-CW switch; stand-by-off—receive switch.

TUBE COMPLEMENT:

RF	1U4	Audio output	3V4
Converter	1L6	Rectifier	Selenium
CW on-IF Amp.	1U4		
2d Det.—AVC—1st audio	1U5		

OTHER SPECIFICATIONS:

Antenna input: 50-300 ohms, unbalanced.
Size: 12-5/16″ wide x 9-11/16″ high x 10″ deep (overall).
Finish: two-tone gray.
Shipping weight: 16 lbs. less batteries.
Optional accessories: RDF-66 Loop, 220V. adaptor.

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Up to 20 months to pay at most Receiver Distributors.
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NC-66

out of 10 U.S. Navy ships use National receivers

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POPULAR ELECTRONICS

VOLUME 7 NUMBER 4

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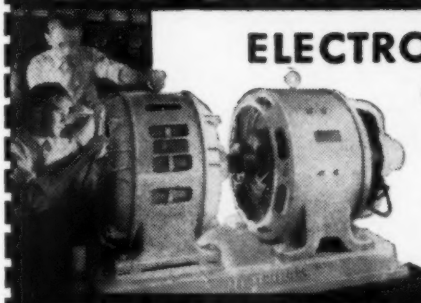

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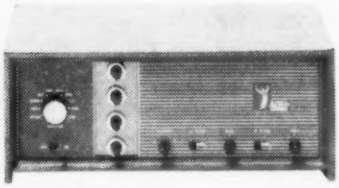
Invites Comparison



The new ALTEC "Quartet" (named for its unique 4 independent volume controls) is the only complete amplifier with all of the control features found in the best separate preamplifiers plus a full 20 watts of power. *Compare* these outstanding features of the "Quartet":

Six Inputs – 3 lo-level for magnetic phono pickup, microphone, and tape deck . . . 3 hi-level for tuner, tape reproducer, and spare.

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Extraordinary sleek design:
Dimensions: less cabinet–4 5/8" H, 13 3/4" W, 7 1/8" D; with cabinet–5 15/16" H, 14 5/8" W, 8 13/16" D.

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COMING NEXT MONTH
(NOVEMBER)

(ON SALE OCTOBER 22)

The principal feature of our November issue will be a comprehensive listing of short-wave broadcasting stations according to their major English language news broadcasts. This listing will enable stations from at least 60 different foreign countries to be readily identified.

In the how-to-do-it vein, the November issue features a transistorized short-wave receiver (as the result of many reader requests). You'll also find a construction article on a crystal calibrator (for the SWL) costing under $10, a homemade crossover network, special information on tape recording and splicing, and numerous other important articles.

IN THIS MONTH'S

RADIO & TV NEWS

(OCTOBER)

Electronics on the Hurricane Ship
Medium Power Color Organ
Tape Your Favorite Programs
Choosing Your Crossovers
A Two-Meter Amplifier

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To enjoy the Club's benefits—mail the coupon, indicating which one of the four Club Divisions best suits your musical taste: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies.

Each month you will receive free the Club Magazine which describes the current selections in all four Divisions. You may accept or reject the monthly selection for your Division . . . or take records from the other Club Divisions . . . thereby assuring you the widest possible choice of recorded entertainment. Or you may tell us to send you NO record in any month. Your only obligation is to purchase four selections from the more than 100 that will be offered during the next 12 months. The records you want are mailed and billed to you at only $3.98 (original cast Musical Shows somewhat higher), plus a small mailing charge.

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The three records sent to you now represent an "advance" of the Club's bonus system—given to you at once. After you have fulfilled your membership obligation by purchasing four records, you will receive an additional free Bonus record of your choice for every two additional Club selections you accept. Bonus records are superb 12" Columbia (LP) records —the very best of the world-famous Columbia (LP) catalog—just like those shown here.

Indicate on the coupon which three records you want free, and the Division you prefer. Then mail the coupon at once. You must be delighted with membership or you may cancel it by returning the free records within 10 days.

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Each month you will send me the Columbia (LP) Record Club Magazine which describes the records offered in all four Club Divisions. I have the privilege of accepting the monthly selection in the Division checked above, or any other selection described, or none at all. My only obligation is to purchase four records in the next 12 months at the regular list price plus a small mailing charge. After accepting four records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

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2. **The Voice** Frank Sinatra in 12 songs that first made him famous — *Lover, Fools Rush In,* etc.

3. **King of Swing: Vol. I** Benny Goodman and Original Orch., Trio, Quartet. *Ridin' High, Moonglow*—9 more.

4. **My Fair Lady** Original Broadway Cast recording with Rex Harrison and Julie Andrews. The complete score including *The Rain in Spain, I Could Have Danced All Night*—14 more.

5. **The Great Melodies of Tchaikovsky** Philadelphia Orch., Ormandy, conductor. 8 memorable selections.

6. **Moonlight Becomes You** Here's mood music in Hi-Fi — Paul Weston and his Music from Hollywood. 12 songs.

7. **Ellington Uptown** Duke Ellington and Orchestra perform *Skin Deep, The Mooche, Perdido*—3 more.

8. **Levant Plays Gershwin** 3 works—*Rhapsody In Blue; Concerto in F; An American in Paris.*

9. **Day By Day** Doris Day sings 12 popular songs—including *The Song Is You, Autumn Leaves,* etc.

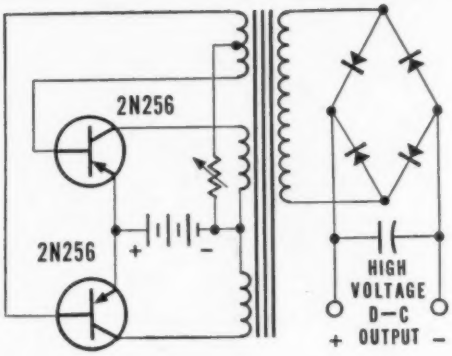
10. **Rimsky-Korsakov: Scheherazade** Philadelphia Orch., Ormandy, conductor. A superb performance of this exotic score.

11. **Music of Jerome Kern** Andre Kostelanetz and his Orchestra play 20 Kern favorites.

12. **Concert by the Sea** Erroll Garner in an actual jazz performance at Carmel, Calif. *Teach Me Tonight, Where or When, I'll Remember April* — 8 more.

PA-1

Transistorized Power Supply



Go modern. Build this transistorized mobile power supply using popular CBS 2N256. Compact combined inverter, rectifier and filter operates from automobile battery. Delivers up to 50 watts d-c output . . . for example, 250 volts at 200 ma. Replaces troublesome vibrator pack or dynamotor. Has no moving parts and offers efficiencies up to 85%. Inverter output is square-wave . . . 0.1 mfd filters it. This easy-to-build supply is ideal for mobile . . . transmitter, receiver, sound system, etc.

CBS 2N255 (6-volt) and 2N256 (12-volt) power transistors are useful in many other economical amplifiers . . . fixed or mobile. Write for CBS Power Transistor Applications, PA-16, for complete details on 15 practical circuits, including this power supply. Or pick up Bulletin PA-16 along with your 2N255 and 2N256 transistors at your CBS Tube distributor's.

CBS-HYTRON

Semiconductor Operations, Lowell, Mass.
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The Cat Gets a Treatment

CARL AND JERRY were sitting on the back step of Jerry's house enjoying the warm October evening. Idly they watched the cat, Eight-To-Go—so named because they figured he had already expended one of his nine lives in the adventure during which they found him—crossing the back lawn with a rather strange gait. Suddenly Carl's dog, Bosco, exploded from where he had been hiding behind a pile of leaves and tore up the sod in pursuit of the cat.

The latter immediately made for a nearby tree and managed to clamber up its trunk out of reach of Bosco, but he succeeded only because the dog suddenly realized that his pursuit was doing too well and braked furiously. Bosco still remembered painfully the time he *had* managed to catch the huge cat with the blazing yellow eyes and the long sharp claws. The dog had learned once and for always that chasing cats is great fun but catching them is something else.

"Hey, Jer, that was pretty close," Carl observed. "Something's wrong with Eight-To-Go's acceleration. I thought he was limping before Bosco took after him. Look at him holding up that right front paw."

"Let's get him down and see what's wrong," Jerry suggested.

After Bosco had been shut in the basement, the boys had no trouble coaxing the cat down from the low limb. Gently they examined the foot that obviously was painful.

"I can't see a thing wrong," Jerry muttered. "There aren't any cuts, and the foot doesn't seem to be swollen."

"I'll bet it's a kind of neuralgia," Carl suggested. "The grass gets pretty cold these nippy fall nights, and Eight-To-Go is not one to stay home at night because of the weather."

"Well, there's not much we can do about that," Jerry said as he ran a gentle hand over the purring body of the great cat.

"And why can't we?" Carl demanded. "Remember the article on diathermy that appeared back in the July, 1957, issue of POPULAR ELECTRONICS? It seems to me

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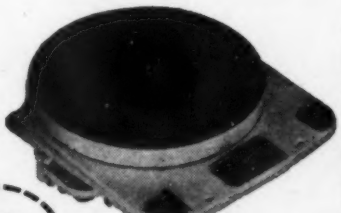
Garrard's most compact, economical changer — fits any cabinet. Simpli-Mix Operation permits stacking all record sizes together. 4-pole motor. Manual position.

RC 98 *Sapphire Changer* **$67.50 net**

All RC 88 features, including full manual position and true-turret drive, PLUS continuous + or — variable speed control on all speeds.



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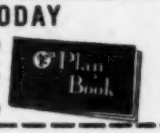

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Carl & Jerry (*Continued from page* 8)

that's just what the doctor would order for Eight-To-Go."

"And where would we get a diathermy machine?" Jerry wanted to know.

"That transmitter of mine will make as good a diathermy machine as anyone could want," Carl boasted. "In fact, several hams have told me that it sounds like a diathermy machine anyway. It's 11-meter band output will allow us to get right on 27.12 mc., which is one of the two frequencies used for this sort of thing. Four-hundred-watt output is supposed to be about right for treating deep-seated ailments in human beings; so I think the hundred watts my ether-buster puts out will be plenty adequate for treating a cat."

"I don't know," Jerry said slowly. "I wouldn't want to do anything to hurt Eight-To-Go."

"So who's going to hurt him? Right in the story it says that when d'Arsonval gave himself the very first diathermy treatment all he felt was 'a pleasant, relaxing warmth deep inside his body.'"

"What kind of applicator electrodes could we use?"

"I was just thinking about that. We can run the pi-network output of the transmitter into my antenna tuner, loading into a hundred-watt lamp in series with a small coil. We'll slip the coil over the cat's paw. That way the current going through the lamp will induce high-frequency currents into the ailing foot. I know capacitor-type

. . . Eight-To-Go made for a nearby tree and managed to clamber up its trunk out of reach of Bosco. "Hey, Jer, that was pretty close," Carl observed . . .

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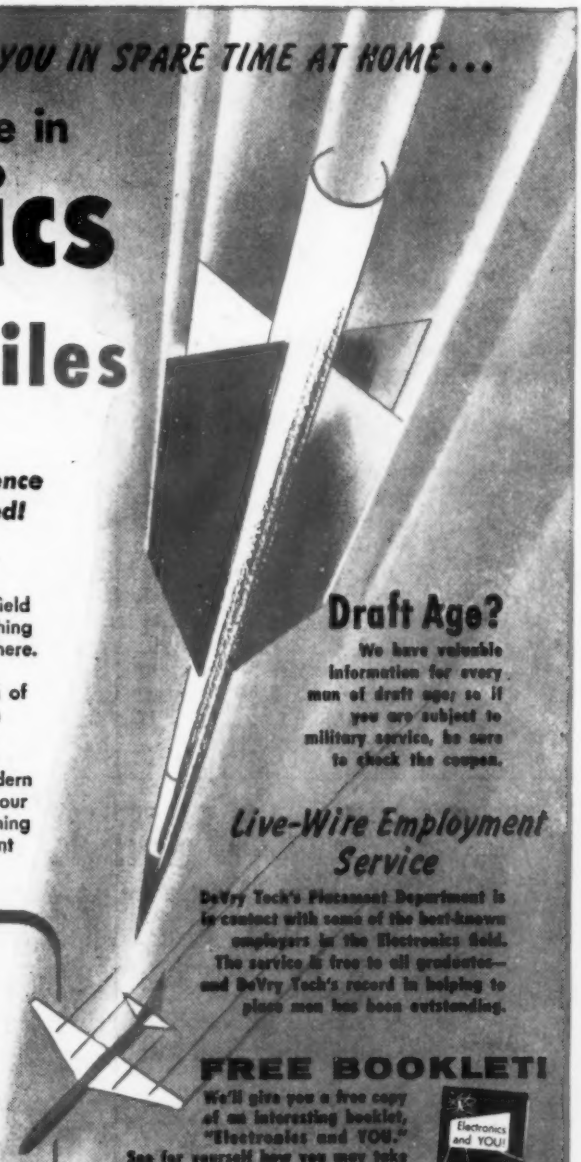

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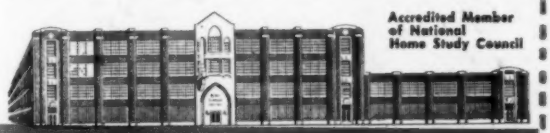

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Carl & Jerry (*Continued from page* 10)

electrodes are supposed to be better at the 27.12-mc. frequency, while the inductor or cable type are used at 13.56 mc., but I don't think we could keep the capacitor type in place on Eight-To-Go."

"I have a sort of uneasy feeling about this whole business," Jerry said; "but I can't resist the temptation to give it a try. So, Dr. Anderson, if you will wheel the patient into the operating room, we will start treatment."

"I'm right with you, Dr. Bishop," Carl said, gathering Eight-To-Go up under one arm.

IT DID NOT TAKE the boys long to set up the apparatus. The lamp and small coil of insulated wire, connected in series, were tapped across a portion of the antenna tuner coil while a standing-wave ratio meter was inserted in the coax line running from the transmitter to the tuner. The transmitter was turned on with the final grid drive adjusted so that only a couple of watts were obtained for actuating the meter. Coil taps were adjusted and the two variable capacitors set to obtain an indicated SWR ratio of 1 to 1. This was done to assure that the transmitter would be working into a proper load and so would suffer no damage. To simulate the presence of the cat's paw, Carl inserted his finger into the small coil while these adjustments were being made.

The SWR bridge was removed from the line, the grid drive increased, and the output adjustments set so that the 100-watt bulb glowed at normal brilliance.

"Put your finger into the coil now for a second or so and see if it begins to feel warm," Jerry suggested. "Don't leave it in there long, though. I still don't feel right about messing around with this sort of thing. Diathermy is something that should only be used by a skilled and licensed technician—even on a cat. I'm pretty sure that prolonged overexposure to diathermy currents could result in permanent tissue damage."

"If you're *that* sure, maybe you'd better put *your* finger in the coil," Carl suggested.

"Sorry, but we can't change fingers now," Jerry said hastily. "It was your finger we used to set up the apparatus, you know; and to substitute another finger now would upset everything. No two fingers are alike—different bone structure, different blood chemistry, different basal metabolism, and all that sort of thing you know. As you always say, I'm half blubber; so put your

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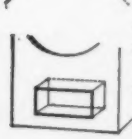

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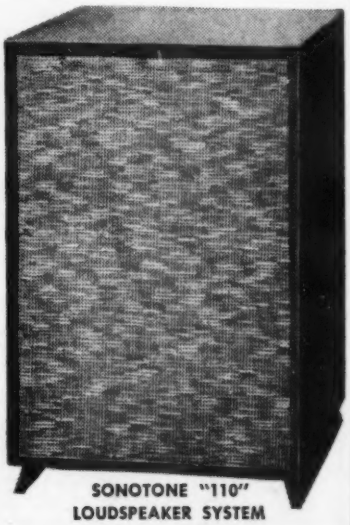

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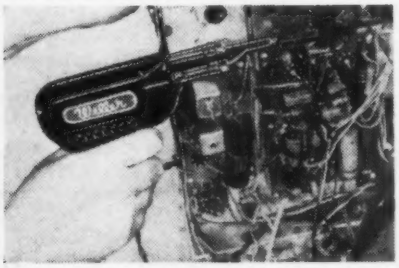

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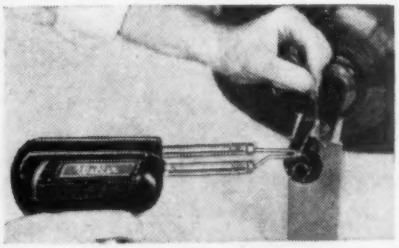

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Carl & Jerry (*Continued from page* 12)

long, lean, bony, muscular finger in the coil and let's see if our gadget is working."

Without further argument, Carl obeyed. As he inserted the tip of his index finger into the small coil of insulated wire, the lamp in series with it brightened noticeably.

"It's working, all right," Carl announced, removing his finger and placing it against his cheek. "Almost right away I could feel my finger warming up."

"Good! Then I guess we're ready for the treatment. You hold Eight-To-Go's foot in that little coil, and I'll operate the transmitter. I'll just cover the lamp bulb with this cloth so it won't startle the cat when the transmitter comes on."

Carl cuddled Eight-To-Go in his lap and gently slipped the small coil over the sore paw. The cat was very relaxed and cooperative. He seemed to know that the boys were trying to help him.

"All set! Flip it on," Carl told Jerry.

Jerry threw the plate switch of the transmitter, and the lamp glowed faintly through the dark cloth. For a scant four or five seconds nothing else happened—Eight-To-Go kept right on purring contentedly in Carl's lap.

THEN ABRUPTLY everything changed. The cat let out a squall of pain and exploded into action. In a blur of motion, it flipped over on its feet and climbed with biting claws up the front of Carl's jacket and across the side of his averted face, knocking off his horn-rimmed glasses on the way. From the top of the boy's head, the animal leaped onto a wardrobe where it perched with its back arched and its tail —swollen to the size of a child's baseball bat—whipping angrily back and forth.

"Whew!" Jerry exclaimed, snapping off the transmitter. "If Eight-To-Go was feeling a 'pleasant relaxing warmth deep in-

. . . Carl cuddled Eight-To-Go in his lap and gently slipped the small coil over the sore paw. The cat seemed to know the boys were trying to help him . . .

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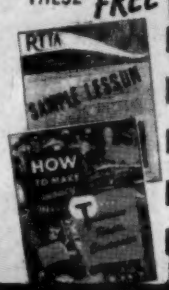

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Carl & Jerry (*Continued from page* 14)

side his body,' he's got a mighty funny way of showing it. Boy, did he ever scratch you! You look like you've been playing peek-a-boo around a thorn tree."

"It's mighty, mighty odd that when anyone gets hurt in any of our experiments it always just happens to be me," Carl observed bitterly as he picked up his glasses, which fortunately were not broken, and went to inspect the damage in the mirror of his dresser.

"Well," he remarked, looking at the blood trickling from the scratches on his face, "at least we must have effected a temporary cure, for old Eight-To-Go was certainly hitting on all fours when he went up over the side of my head. I've got the wounds to show that all four feet were giving him traction."

"I'm afraid the cure was only temporary," Jerry said sadly. "Look at him."

Carl turned around to stare at the cat still perched on top of the wardrobe. The animal was standing on three feet, nervously shaking the sore paw the boys had attempted to treat.

"I just don't understand it," Jerry mused. "The cat couldn't possibly have been shocked or have received an r.f. burn from that setup. Neither can I believe that the diathermy currents themselves could have produced any sensation of pain—at least not so quickly."

"I don't know a thing about that," Carl muttered as he gingerly applied Mercurochrome to the scratches on his face, "but you're going to have a hard time convincing

. . . In a blur of motion, the cat flipped over on its feet and climbed with biting claws up the front of Carl's jacket and across the side of his face . . .

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When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. He was helping wire and install an interoffice phone system. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.
James S. Glen, Jr.,
2920 Knob Hill Rd., Tacoma, Wash.

"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."
Boyd Daugherty, 105 Goodwin Ct., Apt. C., Falls Church, Va.

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Thomas J. Bingham, Finley, N. Dak.	2nd Class	9 weeks

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In what branch of Electronics are you interested?

Name Age

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Desk PE-31

Carl & Jerry (*Continued from page* 16)

me that Eight-To-Go was registering pure ecstasy when he did this to me."

"LET'S get him down and take another look at his paw," Jerry suggested.

"Oh, by all means 'let's!' " Carl said bitterly. "Go right ahead if you want to. Personally, I've had just about all the contact with that animated buzz-saw that I want for one day."

It took a little doing, but Jerry was able to coax the cat down from his perch. He took a good close look at the sore foot under Carl's bright desk lamp.

"Carl, you got a good pair of tweezers?" Jerry suddenly asked.

"Yeah, here's a pair, but what do you want with them?"

"Look closely right in the center of this little white spot on the pad of the cat's foot," Jerry suggested. "See that little black thing sticking out of it? I'll bet that's been the whole trouble. I'm going to try and pull it out."

"There it is!" he announced a moment later, holding the object in the tweezers under the lamp. "It's a very thin, long sliver of steel or iron. No wonder the poor animal's foot hurt."

"I can see why it would hurt when he tried to walk on it," Carl remarked, "but I don't see why it hurt all at once when we were trying to give the foot a diathermy treatment."

"If you want to place that little sliver on your finger and hold it inside the little coil with the transmitter running, I think I can show you," Jerry offered.

CARL gave his chum a long, hard, suspicious look and then placed the tiny bit of metal on the top of his outstretched finger and inserted it in the coil. Jerry turned on the transmitter. In just a matter of seconds Carl felt a slight stinging, burning sensation where the metal splinter was touching his skin. Hastily he jerked his finger back.

"I think I get it now," he said slowly. "Those high-frequency r.f. currents passing through the metal splinter heated it quickly to a high temperature. We were actually giving that poor cat an electronic hot-foot."

"That's the story," Jerry said, as he applied a drop of Mercurochrome to the spot from which the steel splinter had been removed. "Shall we call the operation a success?"

"And why not? Even doctors can make a wrong *preliminary* diagnosis. The patient was finally cured, and that's the important thing!" —30—

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Both models use standard batteries available at your local radio store. All components guaranteed for one year against defects in manufacture.

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Very active quartz transmitting crystal ground to .01% of your desired frequency and hermetically sealed	$ 3.98
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Handset output transformer	$ .98
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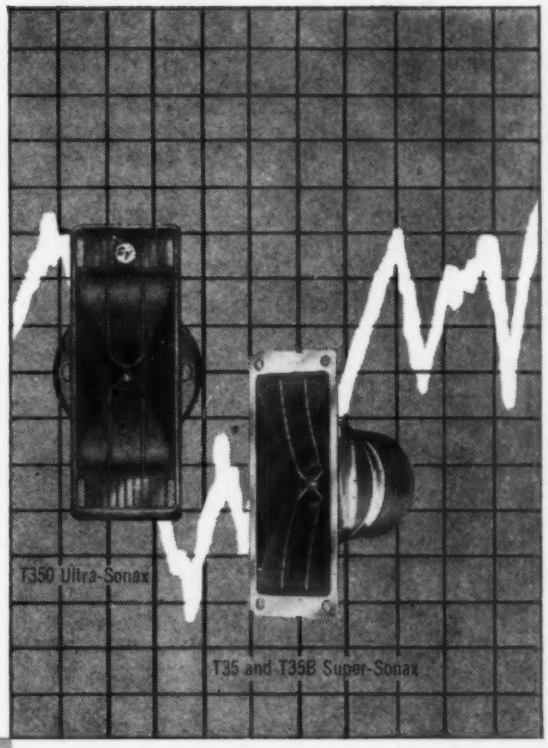
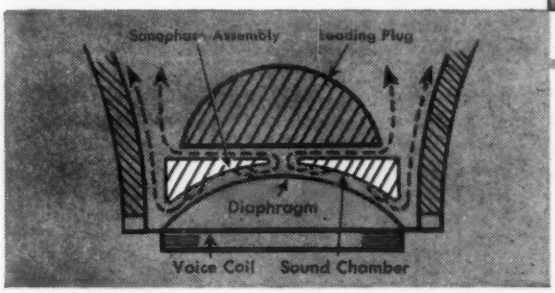
No other manufacturer gives you very high frequency drivers combining all the customer benefits of these unique new Electro-Voice models. Today's folded horn and phase loaded speaker systems with their low first-octave response *require* flat, extended high range response beyond the very limit of audibility if essential musical balance is to be achieved. These very high frequency drivers, employing the time-tested diffraction principle and the new Avedon Sonophase throat design, overcome range and sensitivity limitations, function without distortion at the highest ranges.





Specifications	T35	T35B	T350
Frequency Response:	±2 db 2 kc—19 kc	±2 db 2 kc—18 kc	±2 db 2 kc—21kc
RETMA Sensitivity Rating	57 db	54 db	60 db
Magnet Weight:	7 oz.	4 oz.	1 lb.
Gauss	13,500	9,000	20,000
Size:			
Horn:	5¼ in. long x 2 in. wide		7½ in. long x 2½ in. wid
Pot Diameter:	2¼ in. maximum		3½ in. maximum
Depth.	3¼ in. overall	3 in. overall	4½ in. overall
Shipping Weight:	3 lbs.	3½ lbs.	9½ lbs.
Net Price:	$35.00	$22.00	$60.00

And These are the Reasons Why

The Avedon Sonophase Throat Design

The unique throat design illustrated here overcomes a problem common in conventional high frequency drivers. This is diaphragm deformation at high frequencies, occuring at frequencies above 5 kilocycles. Piston action is destroyed, the phase is shifted and the result is destructive interference.

These Electro-Voice UHF drivers solve the diaphragm deformation problem with a longer sound path from the center of the diaphragm. This restores proper phase relationship. This is important above 12 kilocycles, where sound must be taken from the center of the diaphragm *and* from the outer edge simultaneously. The diagram shows E-V's Sonophase construction.

All three models—T35, T35B and T350—have 180° dispersion patterns, program capacities of 50 watts, peak 100 watts, voice coils one inch in diameter and 16 ohms impedance. Chart shows other characteristics of each model.

TODAY write for Bulletin E710.

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LETTERS FROM OUR READERS

Some Mixed Results

■ I built a VHF Ear (July issue) with some variations. I poured an old Zenith hearing-aid amplifier into the bottom half of a telescoping plastic cigaret case, and built a one-transistor version of the "Ear" into the top half of the case. With this arrangement in my pocket, I monitored all the take-offs and landings from Springfield, Mass., to St. John's, Newfoundland, including one GCA landing. Inasmuch as I was feeding the amplifier through its 1.6-mc. input, I used the hearing-aid 22½-volt positive battery, instead of 1.5 volts on the transistor.

C. F. ANDREWS
West Springfield, Mass.

■ I carefully assembled the VHF Ear and took off for the local commercial airport. About 150 feet from the tower, I put the phone in my ear and tried tuning in what I thought would be a lot of chatter from this busy tower. All I got was a "beep" every few seconds. I was trying to get voice signals.

The "beep" gradually faded away and then I got absolutely nothing, although I rotated the capacitor slowly, straining for any sound. Just as I was ready to chuck the whole thing, clear as a bell came: "Army 214, the time is 0941 and one quarter, over." I spent another 15 minutes vainly trying to pick up other messages, with no luck.

JAMES M. BATES
Windsor Locks, Conn.

Here we have two versions of the same story. Maybe, Jim, the field wasn't that busy.

A Woman Speaks

■ In answer to the writer who inquired about women readers (August issue), may I please point out that I am most certainly not the lone member of the opposite sex to read this magazine. There must be other women hams who enjoy reading electronics articles that are not too difficult.

MARGARET LE FEVRE, K2BSH
Pavilion, N. Y.

Thanks, Margaret. Any more of you out there?

Build An Oscilloscope

■ How about giving plans for the construction of a practical oscilloscope using the cathode-ray tube and as many parts as possible from a junked small-screen TV set?

LORAN MCKINLEY
Hamilton, Ontario

We feel it would be extremely unwise, Loran. For instance, how would you vary the sweep frequency in the cathode-ray tube? Also, the TV set employs extremely high voltages which are not for just playing around. We recommend a kit.

Club News

■ Could I enlist your aid in forming a club devoted to the study of all types of scopes and

Prepare for a Good Paying Job—Or Your Own Business

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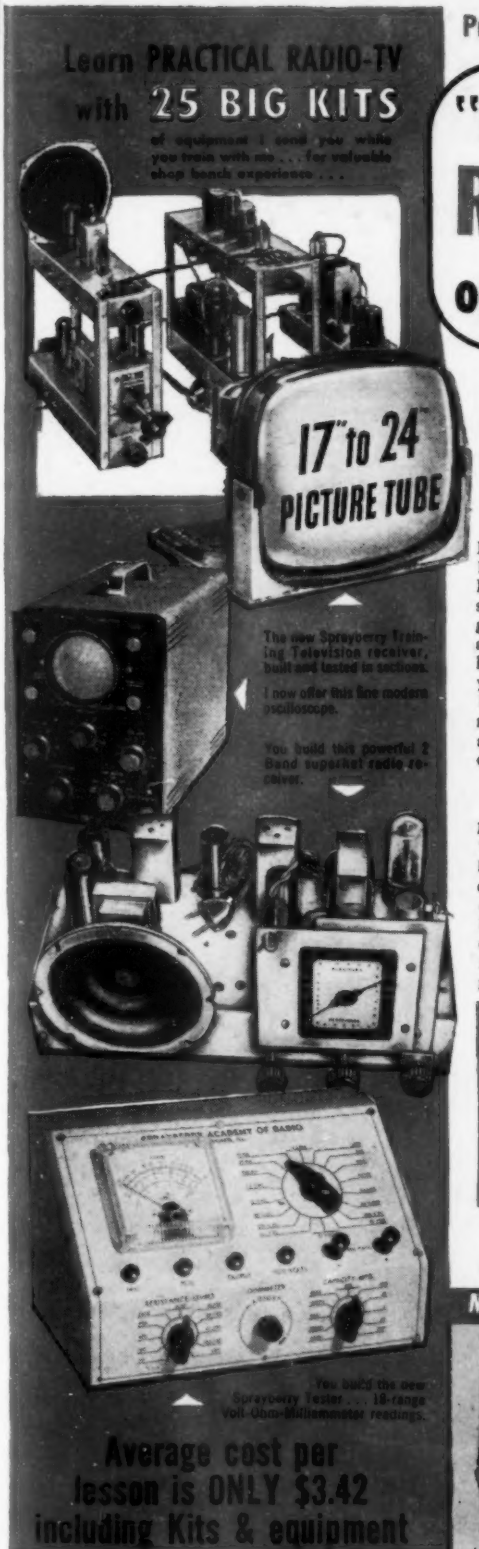
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various signal generators? I don't believe there is any such group in the Los Angeles area.

JULIAN KOOMER
136 N. Mariposa Ave.
Los Angeles, Calif.

Anyone in the Los Angeles area interested? Contact reader Koomer.

A Knock . . .

■ Referring to the "Tip and Technique" (August issue) on kerosene for plastic meter faces, I feel this is definitely unsafe. Kerosene, though not a solvent for many plastics, will cause molded polystyrene to reveal its residual stresses by cracking and crazing. This action is sometimes immediate and sometimes requires a few hours, depending on the amount of "locked-in" stress and the grade of kerosene or similar hydrocarbons.

ROBERT NIELSEN
Los Angeles, Calif.

Thanks, Bob, and a tip of the hat to you.

. . . and Some Boosts

■ As a charter subscriber, I feel indebted to you for a great deal of knowledge I have acquired. I

am just an old electrician but have completed 12 kits. The photograph above is a picture of my corner.

JOHN L. LOWRIMORE
Vacaville, Calif.

Glad to hear from an old hand like you, John. The youngsters like us, too, as you can see below.

■ I finally got around to building the electronic electroscope (April issue). It works wonderfully, and with a few changes and maybe a few more parts it could be used as a helpful test instrument in the workshop. I am just 16 years old and like your magazine very much. I think *Carl and Jerry* are wonderful. Keep up the low-cost projects for people like myself who have a thin pocketbook.

DAVID PEACOCK
Winona, Miss.

Thanks, Dave. It brings a flush of pleasure to our faces to hear from youngsters like you.

■ I just want to say what a swell magazine I think you have. I'm taking a correspondence course in radio and TV, so am a newcomer in the field. I have been re-reading "How to Use Ohm's Law"

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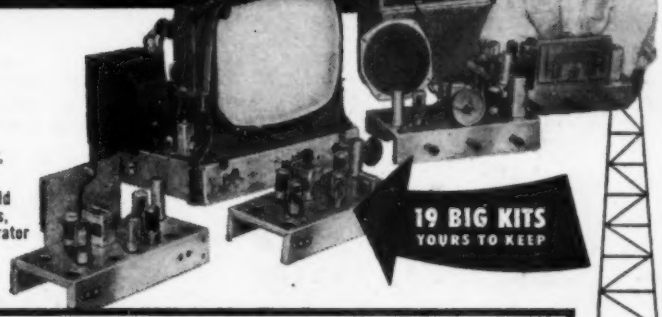

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Letters

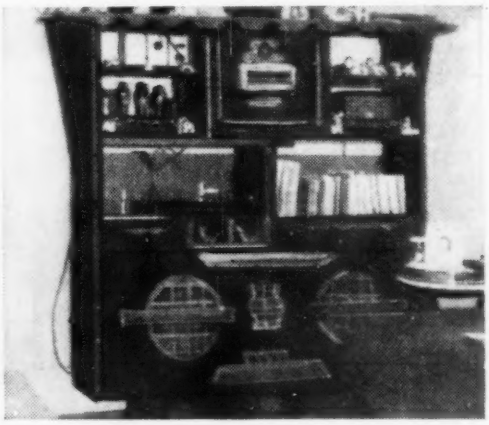
(*Continued from page 22*)

(February, 1956 issue). It cleared up quite a few questions I couldn't quite figure out the answers to from my lessons.

WILLIAM HOOVEN
Camden, N. J.

Stick with us, Bill. You'll find lots more to help you in forthcoming issues.

■ The magazines on the shelf of my "Hi-Fi Box" are issues of POPULAR ELECTRONICS. The rig has



two record players, a 20-watt amplifier, FM radio, bookshelf, record rack, "whatnot" shelf space, four speakers, a second radio (2-band), equalizer and crossover. A shot of this assembly recently ran in a Tulsa newspaper.

CHARLES HUNT
Tulsa, Okla.

Looks pretty professional from here, Charles. Thanks for the look-see.

Dep't. of Amplification

■ That mobile antenna picture in the May issue, page 42, is an Alford Loop, and is essentially non-directional. The size varies with the frequency, and from the photo it looks as if it's cut for receiving the 88-108 mc. FM band.

EDWARD K. CONKLIN
Farmington, Conn.

That's exactly correct, Ed. Some of those guesses in our last issue were rather close, weren't they?

Dep't. of Modification

■ For those building the AT-1 Modulator ("Modulating your Heathkit Transmitter," August issue, page 53) the following might help: *R1* should be reduced to 270 ohms instead of the 470 ohms I specified in the parts list. This change improves voice quality.

JAY STANLEY

Many thanks, Jay.

Dep't. of Congratulations

■ I have just completed the "Lucky 15" preselector described in your October 1956 issue, and it is a complete success. The "Lucky 15" has not

(*Continued on page 30*)

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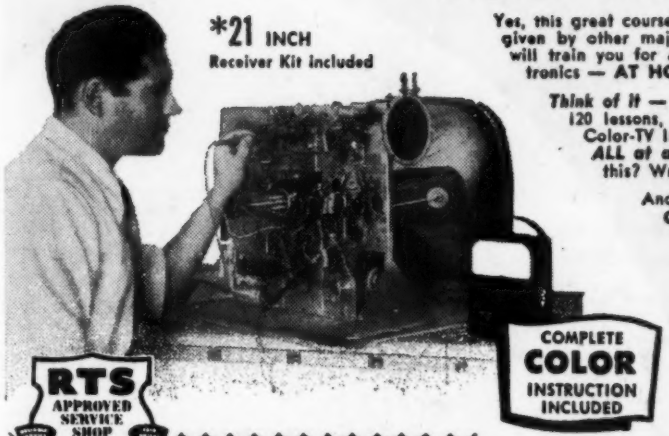

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FOR UNSKILLED INEXPERIENCED MEN ONLY — WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

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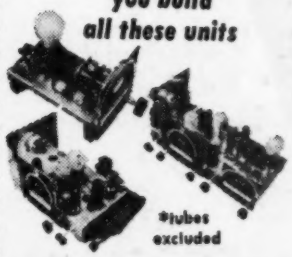
When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words ***we will stake you*** . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build all these units



*tubes excluded

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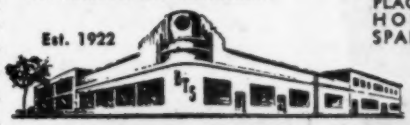

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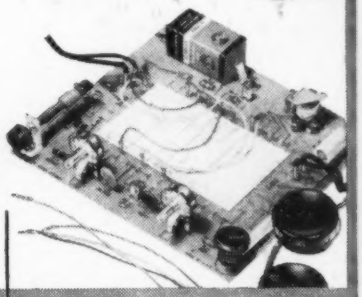

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767 $2.45

Tiny, cigarette-pack-size 1-transistor radio kit—fascinating to build. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Features: ferrite core tuned coil; low-drain transistor operating for months from single penlight cell; handsome plastic case. Complete with all parts, transistor, battery and easy-to-follow instructions. (External antenna required.) A wonderful value. Shpg. wt., 8 oz.

Model Y-767. Net only.....$2.45

J-149. Headphones. 1¼ lbs....$2.15

C-100. Antenna Kit. 1½ lbs....$1.03

knight-kit 5-Transistor Superhet Portable Radio Kit

Model Y-766 $29.95

Handsome, easy-to-build personal portable with every ultra-modern design feature: 5 transistors (up to 200 hours playing time from 9v. battery supplied); printed circuit for easy building; big 3½" speaker; push-pull audio output; built-in ferrite loopstick antenna. Sensitive reception of AM broadcast band with exceptional tone. In ultra-smart high-impact ivory plastic case with handsome gold trim; size only 7½ x 3¾ x 1¾". With all parts, transistors, battery and instructions. Shpg. wt., 2 lbs.

Model Y-766. Net only.....$29.95

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299 $15.75

Sensational transistor hobby kit! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio; amplifier; wireless oscillator; code practice oscillator; electronic timer, switch or flasher; voice-operated, capacity-operated or photoelectric relays. Includes all parts, 2 transistors, battery, headphones, instructions for each project. Shpg. wt., 3 lbs.

Model Y-299. Net only.....$15.75

Model Y-262 $14.65

knight-kit 2-Transistor Pocket Radio Receiver Kit

It's fun to build this pocket-size two-transistor radio—enjoy loud, clear local broadcast-band reception wherever you go! Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides remarkably fine tone. Complete with all parts, including plastic-impregnated case, earpiece, battery and transistors. 4 x 3¾ x 1¾". Shpg. wt., 1½ lbs.

Model Y-262. Net only.....$14.65

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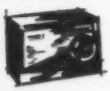
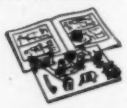
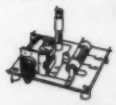


"RANGER" SUPERHET BROADCAST RECEIVER KIT. Y-735 $17.25

"OCEAN HOPPER" SW RECEIVER KIT Y-740 $11.95



"10-IN-ONE" ELECTRONIC LAB KIT Y-265 $12.65



TRANSISTOR RADIO RECEIVER KIT Y-765 $3.95

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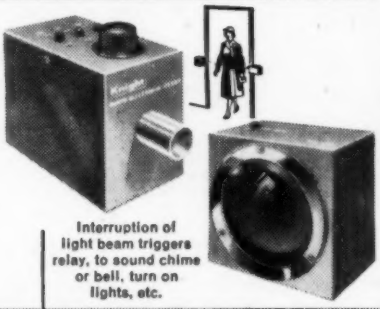


Interruption of light beam triggers relay, to sound chime or bell, turn on lights, etc.

knight-kit Transistorized Code Practice Oscillator Kit

Model Y-239 $3.75

Advanced-design code practice oscillator—ideal for beginners learning the code. Uses transistor circuit—operates for months from a single penlight battery. Has clear, crisp tone of approximately 500 cycles. Includes jacks for headphone tips; screw terminals for key. Compact black bakelite case with aluminum panel, only 2⅜ x 3¾ x 1½". Complete with all parts, transistor, battery and step-by-step instructions for quick, easy assembly. (Less earphones and key.) A fine code practice kit at very low price. Shpg. wt., 1 lb.

Model Y-239. Net only.....$3.95

knight-kit Photo-Electronic Relay Kit

Model Y-702 $13.50

Advanced-design, ultra-sensitive photo-electronic relay—build it yourself and save! Covers 250-ft. with white light; 125-ft. with "unseen" (red filter) light (made available in Light Source Kit listed below). Ideal as announcer, counter, burglar alarm (can be set to ring bell continuously when beam is broken). Hundreds of uses. SPST relay contacts. 6.3v. terminals provide power for accessories. 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net..$13.50

Model Y-703. Light Source Kit. With long-life sealed beam bulb and red filter. Shpg. wt., 3½ lbs. Net.$6.75

knight-kit 2-Way Intercom System Kit

Model Y-295 $14.75

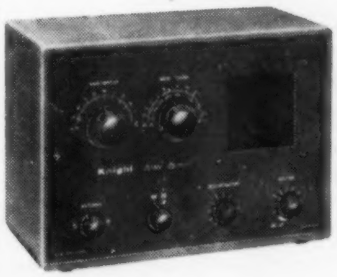
Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left "open" for switchless answering and baby-sitting. In "closed" position, Remote is private", but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. Delivers full volume from only a whisper. With tubes and 50-ft. cable (up to 200-ft. may be added). Antique white finish. Size each unit, 4¾ x 6½ x 4⅜". For 110-120 v. AC or DC. Shpg. wt., 8 lbs.

Model Y-295. Net only.....$14.75

knight-kit "Space-Spanner" Bandswitching Receiver Kit

Model Y-243 $15.95

Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short wave, including foreign broadcast, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power output for strong volume. Headphone connectors are available for private listening; switch cuts out speaker. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build from step-by-step instruction manual. 7 x 10 x 6". For 110-120 volt, 50-60 cycle AC or DC. Shpg. wt., 5 lbs.



Model Y-243. Net only.....$15.95

Y-247. Matching cabinet for above.....$2.90

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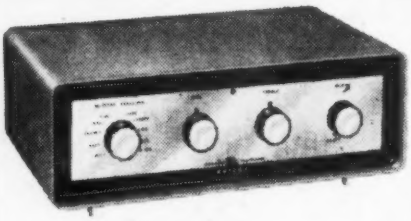


- All-New Custom Styling
- Exclusive Printed Circuit Switch
- 8 Inputs for Every Signal Source
- Full 18-Watts with Superb Specifications

knight-kit Complete 18-Watt Hi-Fi Amplifier Kit

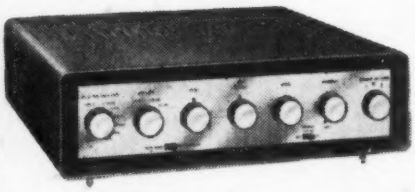
Model Y-786

$39.95

Only $3.99 down

Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at unbeatable low cost. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. Delivers full 18 watts output at only .5% distortion; uses new RCA 6973 hi-fi output tubes; frequency resonse, ± 1 db, 20-30,000 cps; tape head and magnetic cartridge sensitivity, 5 mv for 18 watts output; hum and noise level better than 60 db below 18 watts; output taps for 4, 8 or 16 ohm speakers. Separate bass and treble controls; full record equalization. Simplest assembly is made possible through use of exclusive printed circuit switch and two printed circuit boards—no critical wiring to do. With beautifully styled custom cabinet; 4 x 13 x 8". Complete with cabinet, tubes, step-by-step instructions. Shpg. wt., 15 lbs.

Model Y-786. 18-Watt Hi-Fi Amplifier Kit. Net only..... **$39.95**



- New Printed Circuit Switches
- Three Printed Circuit Boards
- 8 Inputs • Full Equalization
- Full 30 Watts • Custom Cabinet

knight-kit Complete 30-Watt Hi-Fi Amplifier Kit

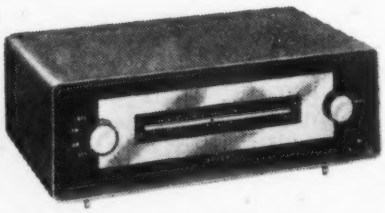
Model Y-762

$76.95

Only $7.69 down

Comparable to the best—and you SAVE MONEY! Advanced features include: Linear-deluxe, Williamson-type circuit; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed-circuit switches; 3 printed-circuit boards for time-saving, error-free assembly; separate continuously variable Level and Loudness controls; 8 inputs for every signal source; DC on all filaments of preamp tubes; exclusive 3-way speaker selector switch (use speakers of mixed impedances without mismatch!); Power Amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts; rumble filter switch; variable damping. Output 8 and 16 ohms. With cabinet, 4¼ x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only..... **$76.95**



- Latest Printed Circuit Design
- Flywheel Tuning • Built-in AFC
- High Sensitivity • Hi-Fi Response
- Advanced Custom Styling

knight-kit FM-AM Hi-Fi Tuner Kit

Model Y-787

$49.95

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The best-looking, best-performing FM-AM tuner your money can buy! Covers full AM broadcast and 88 to 108 mc FM. Sensitivity is 2.5 microvolts for 20 db of quieting on FM; 3 microvolts for 10 db signal-to-noise ratio on AM. Features include: Inertia Flywheel Tuning for easy, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board for time-saving, error-proof assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; built-in AM ferrite antenna. Ideal for use with KNIGHT-KIT amplifiers above. Includes handsome, custom-styled case, 4 x 13 x 8". Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Hi-Fi Tuner Kit. Net only..... **$49.95**

knight-kit 2-Way "Ducted Port" Complete Speaker System Kit

Model Y-789

$49.95

Only $4.99 down

BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-Way Speaker System—it's easy! Cabinet is pre-finished—you just assemble 7 pieces, mount the speaker components and enjoy rich Hi-Fi sound. Special Jensen-engineered baffle features "ducted port" construction to enhance bass response. Kit includes Jensen 12" woofer and compression-type tweeter; genuine L-pad control permits adjustment of tweeter for best tonal balance. Impedence, 16 ohms. Assembled unit delivers frequency response of 45-14,000 cps. Enclosure measures 26 x 19 x 14". Kit includes everything required for easy assembly. Specify blonde or mahogany finish when ordering. Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit.
Net only **$49.95**

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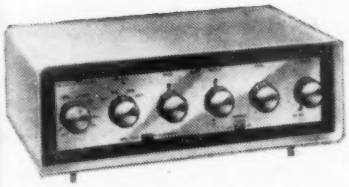


Model Y-754

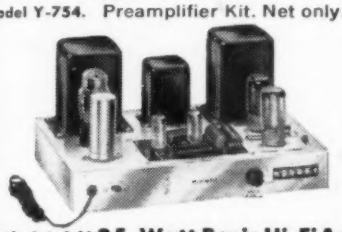
$39.95

Only $3.99 down

knight-kit Deluxe Hi-Fi Preamplifier Kit

Sensational Hi-Fi design at new low cost! Features precise record equalization guaranteed within ½ db of recommended accuracy! Exclusive new printed-circuit switches and 2 printed-circuit boards for easy, error-free assembly; built-in power supply; response, ± 0.5 db, 10-50,000 cps; 8 inputs (including Tape Head); separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output. Beautiful custom-styled case, 4 x 13 x 8". Complete with case. Shpg. wt., 12½ lbs.

Model Y-754. Preamplifier Kit. Net only..... **$39.95**



Model Y-755

$44.50

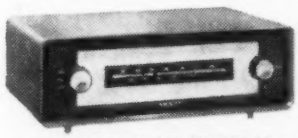
Only $4.45 down

knight-kit 25-Watt Basic Hi-Fi Amplifier Kit

Here's superb Hi-Fi performance at less than half the cost of a commercially assembled unit. Williamson-type linear-deluxe circuit delivers full 25 watts of virtually undistorted reproduction; use with KNIGHT-KIT preamp above. Printed circuit board. Response: ± 0.5 db, 10-120,000 cps at 20 watts. Distortion: 0.15% at 30 watts. Output Impedance: 4, 8 and 16 ohms. Includes balance control, variable damping control. Chrome-plated chassis; 6¼ x 14 x 9". Ready for easy assembly. Shpg. wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only... **$44.50**

Y-759. Metal cover for above. Wt., 3 lbs..... **$4.25**



Model Y-751

$38.95

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knight-kit Hi-Fi FM Tuner Kit

The last word in looks, quality, performance and low cost. Covers 88 to 108 mc; features Automatic Frequency Control (with special disabling circuit); flywheel tuning; pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; illuminated lucite pointer. Sensitivity is 5 microvolts for 20 db of quieting across entire band. Cathode follower output. Ideal for use with KNIGHT-KIT amplifiers on opposite page, or any amplifier with phono-tuner switch. With custom-styled cabinet, 4 x 13 x 8". Shpg. wt., 12 lbs.

Model Y-751. Hi-Fi FM Tuner Kit. Net only. .. **$38.95**

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knight-kit 1000 OHMS/VOLT VOLT-OHMMETER KIT

Low-cost 38-range VOM—exceptional for quality. Features 4½" meter; 1% precision resistors. Ranges: AC, DC and output volts, 0-5000 in 7 ranges; Resistance, 0-1 meg in 3 ranges; DC ma, 0-1 amp in 4 ranges; Decibels, −20 to + 69. Black bakelite case, 6¾ x 5¼ x 4¾". Easy to assemble. Complete with all parts, including battery and test leads. Shpg. wt., 3 lbs.

Model Y-128. Net..... **$16.95**

Model Y-125

$24.95

knight-kit VACUUM TUBE VOLTMETER KIT

Printed circuit board for easy wiring. Easy-to-read 4½" meter; 200 ua movement. Zero-center scale, direct-reading db scale. Polarity reversing switch. Response, 30 cycles to 3 mc. Input resistance, 11 megs. Ranges: AC peak-to-peak v., 0-4-14-40-140-400, 1400, 4000; AC rms v. and DC v., 0-1.5-5-15-50-150-500-1500; ohms, 0-1000-10K-100K; 1-10-100-1000 megs; db scale, −10 to +5. 7¾ x 5¼ x 4⅜". Shpg. wt., 7 lbs.

Model Y-125. Net..... **$24.95**

See our 1958 Catalog for the complete line of KNIGHT-KIT Test Instruments, including Oscilloscopes, Tube Checker, Audio Generator, Signal Tracer, Sweep Generator, Signal Generator, R/C Tester, Flyback Checker, Transistor Checker, etc. Send for your Free copy today.

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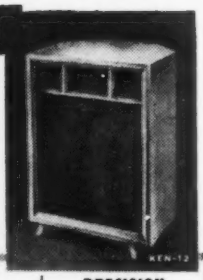

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LISTEN *University sounds better*

Letters

(*Continued from page 24*)

only opened up the 15-meter Novice band for me, but has done so at a cost far below that of any other way open to me. Thank you very much for making it possible for me to have this fine piece of equipment in my shack.

JOHN KRIEG, KN2ZGF
Middletown, N. J.

It's our pleasure, John. Keep watching POP'tronics for more such projects. They'll be coming along soon.

Dep't. of Information

■ This letter speaks for a lot of us readers who have an interest in the most modern branch of electronics—computers, memory circuits, etc. There are many simple circuits which could be adapted for the home experimenter. Could you show us some of them soon?

BOB TRAGESSER
Wilmette, Ill.

Turn to "After Class" in this issue, Bob.

■ Sometimes when tuning between 10 and 30 mc., we get "buzz-saw" signals. What are they?

BILL HODSON
LANNY ELPHIC
Redlands, Calif.

What you hear, fellows, is radioteletype or frequency shift keying, perhaps from the U.S. to Europe. The buzz is actually code being sent at 100 words a minute or so—a good reason for only "noise." —30—

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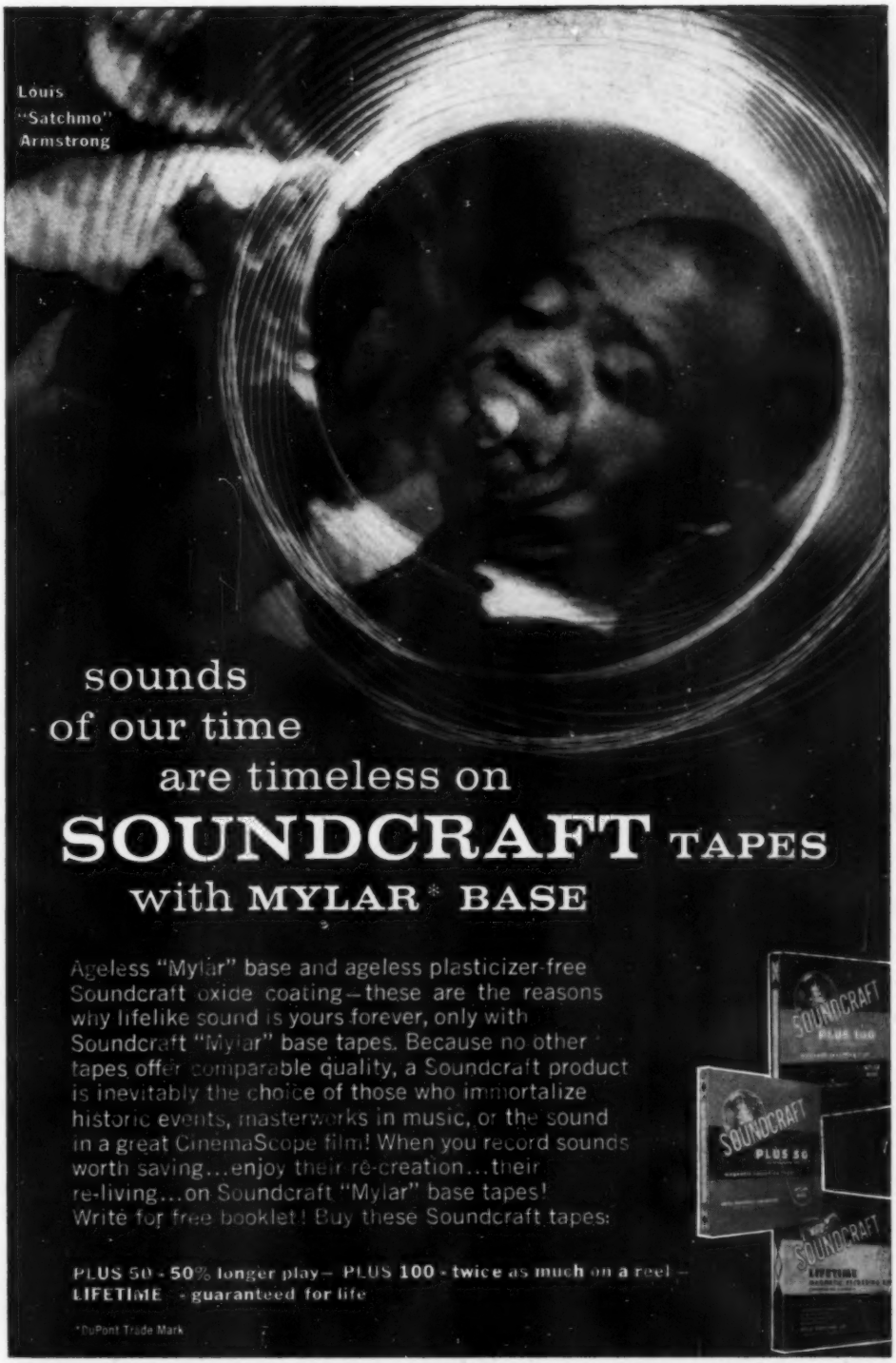

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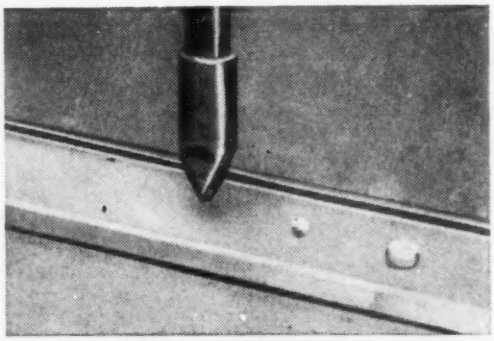
TIPS and TECHNIQUES

IRON AIDS ACCURATE DRILLING

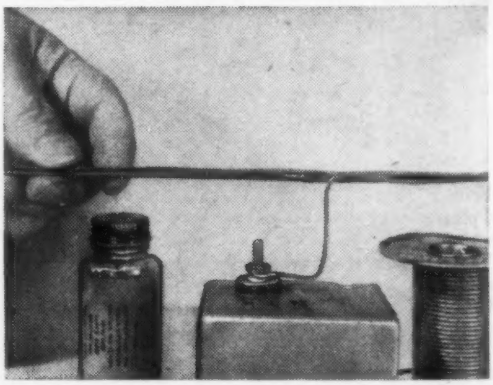
When a hole must be drilled precisely in plastic, an indentation made by touching



the tip of a hot soldering iron to the spot will serve to start the drill. Coil forms of Bakelite and other insulating material can be drilled more accurately using the same method. —*J. A. C.*

CEMENT FOR NEATNESS

Exposed circuit wiring will have a neat, clean appearance if you cement parallel wiring together. Just dab the wires with



rubber cement, then press them together with your fingers. This method is quicker than bunching wires together with a string. —*K. M.*

BULB STORAGE IN FILM CAN

To store pilot lamps and flashlight bulbs where they won't get lost or broken, keep them in an empty 35-mm. film container. A slip-on pencil eraser placed over the en-

New Transcription-Type Tone Arm Makes *Collaro* World's First True High Fidelity Changer

The Turntable That Changes Records

From Collaro, Ltd., world's largest manufacturer of record playing equipment—comes the most significant development in the field in years—the new transcription-type tone arm.

This arm, exclusive with Collaro, literally changes the conventional record changer into a brand new instrument — a TRANSCRIPTION CHANGER — with features of the finest professional equipment.

The arm is a one-piece, spring-damped, counter-balanced unit which will take any standard high fidelity cartridge. It is free of any audio spectrum resonances. It permits the last record to be played with the same low stylus pressure as the first. Between the top and bottom of a stack of records there is a difference of less than a gram in tracking pressure as compared with 4 to 8 grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level. These qualities, found only in the Collaro Transcription Changer, insure better performance and longer life for records and styli.

In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment. Here, for the first time in a changer is professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of the Mississippi.)

In addition to the new tone arm, the Collaro Continental features include: 4 speeds, manual switch for turntable operation; wow and flutter specifications — 0.25% RMS at 33⅓ RPM — superior to any changer in the world; automatic intermix; automatic shut-off after last record; heavy duty 4-pole, shaded pole induction motor; heavy rim-weighted balanced turntable; muting switch and pop-click filter for elimination of extraneous noises; jam proof machinery; pre-wiring for easy installation; attractive two-tone color scheme to fit any decor; tropicalization to operate under adverse weather and humidity conditions; easy mounting on pre-cut board or base; custom testing at the factory for wow, flutter, stylus pressure and correct set down position.

FREE: Colorful new catalog describes complete Collaro line. Includes helpful guide on building record collection.

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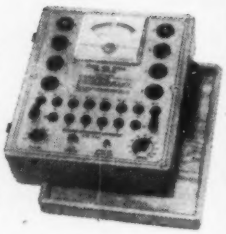
Rockbar is the American sales agent for Collaro and other fine companies.

NEW! EMC Model 301 Speedi Tube Tester



Precision crafted for checking tubes in seconds. Only 2 settings to make. Checks for shorts, leakages, and quality. Over 375 tubes now listed, including 0Z4 tube. New listings available. Uses line voltage regulation. Saves precious time and quickly pays for itself. Also available with 7½" meter.

Model 301P, illustrated with 4½" plastic front meter, in oak carrying case, **$47.50; In Kit Form, $33.20.**

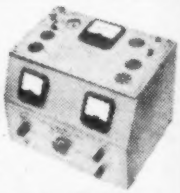
Model 301C, Sloping Counter Case, **$46.50; Kit, $32.60.**

Model PTA, Picture Tube Adaptor (to check and rejuvenate picture tubes) **$4.50**

NEW! EMC Model 108 Handi Tester

The only appliance and auto battery tester in its price class to use a D'Arsonval, instead of an iron vane type meter. You get exclusive advantages of maximum accuracy, maximum scale length, and minimum battery replacement cost . . . at no extra cost. Complete with test leads and instruction manual. Wired, **$15.95; In Kit Form, $12.95.**

NEW! EMC Model 905-6A Battery Eliminator, Charger, and Vibrator Checker



A MUST for auto radio service. Features continuously variable voltage output — in either 6 or 12 volt operation. Checks all 6 or 12 volt vibrators. **Model 905-6A** (Comb.) Wired, **$67.90; Kit, $44.90. Model 905,** Battery Eliminator and Charger (only) Wired, **$37.50; Kit, $28.90. Model 906,** Vibrator Checker (only) Wired, **$31.80; In Kit Form, $17.05.**

NEW! Model BEA, Battery Eliminator Adaptor (for Transistor Radio Checking) ..... Wired, $9.70

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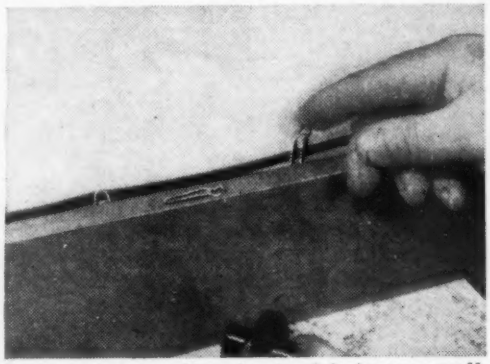
Tips

(*Continued from page 32*)

velope of each bulb is a further safeguard if the can of bulbs is carried in a tool kit. —*J. A. C.*

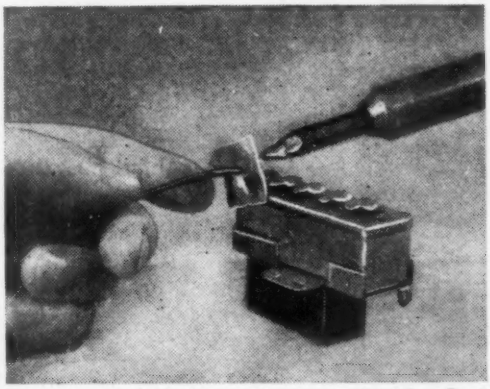
PAPER CLIPS AS MOULDING CLIPS

Special clips are made for holding extension wire neatly along baseboard moulding, but paper clips do the job just as well. Put a slight bend in the larger loop at one end of each clip, then push the other end between baseboard and wall. —*K. M.*



FOIL PROTECTS WIRE

The insulation on a wire will be protected from charring if a small piece of aluminum foil is used as a shield. Just punch a hole in the foil with a nail, slip it over the wire and tear it off when the soldering job is completed. —*K. M.*



SHOCKPROOFING TABLE RADIOS

A.c./d.c. table radios which have metal-plate bottoms to which the chassis is screw-fastened can be dangerous. If the chassis (and hence the metal bottom plate) is connected to one side of the a.c. line, placing the radio on a metal sink or gas range can blow a house fuse. Small children might touch the bottom plate while in contact with a grounded object (see page 58). It's a good idea to replace metal bottom plates with duplicates made of Masonite or Presdwood. This insulating

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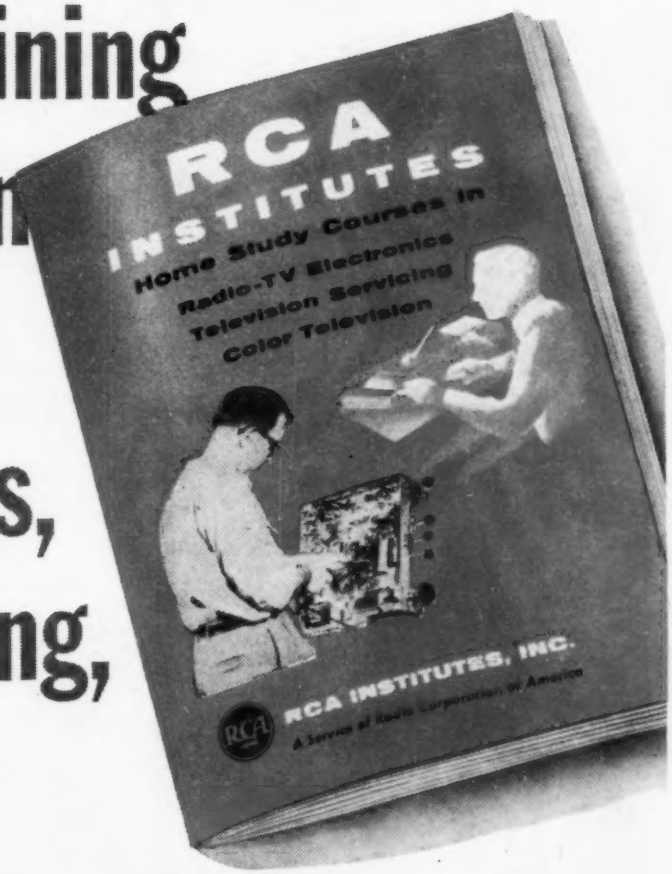

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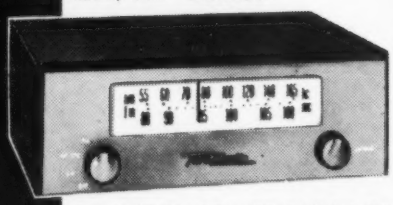
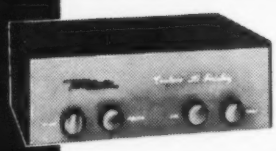


2 uv for 20 DB quieting, AFC plus Defeat, Full Frequency Response, 300 KC bandwidth.

Model KC-400 Less Cage $34.95 (FED. EX. TAX INC.)
Wired and Tested 59.95



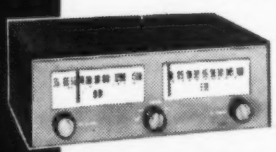
20-WATT INTEGRATED AMPLIFIER

Power Response CONSTANT at 20 Watts, 1 ± DB Full Frequency Response, Infinite Equalization Bass Treble Controls; 3 Hi, 1 Low inputs.

Model KC-401 Less Cage $46.00
Wired and Tested 64.95

Exclusive!

STEREOPHONIC KITS



AM/FM STEREOPHONIC TUNER WITH WIRED FM FRONT END

NEW DIMENSIONS IN SOUND—Each section used individually or together—0.9 uv for 20 DB quieting, 330 kc Bandwidth 3-gang variable AM tuning, 15 uv per meter loop sensitivity.

Model KB-402 Less Cage $69.95 (FED. EX. TAX INC.)
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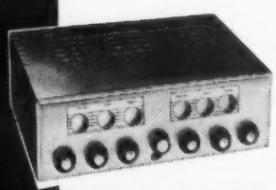


40-WATT STEREOPHONIC AMPLIFIER

NEWEST DEVELOPMENT IN STEREOPHONIC SOUND FOR THREE DIMENSIONAL LIFE-LIKE REALISM!
Twin 20-Watt Channels—Each with FULL PRE-AMP sections and Master Volume Control.

Model KB-403 Less Cage $ 82.50
Wired and Tested 109.50

For full details, see your local dealer or write

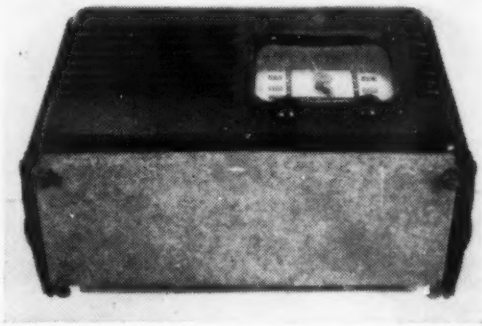
TELEMATIC INDUSTRIES, INC.

16 HOWARD AVENUE, BROOKLYN 21, N. Y.

Tips

(*Continued from page* 34)

board can be screw-fastened to the bottom of the cabinet or chassis as the metal plate was before. It would be best to paint the exposed chassis screw heads with Duco



cement and then cover them over with strips of insulating tape to avoid the possibility of a short from that area. Any exposed screws on the back cover which contact the chassis should be insulated in the same way. —*A. T.*

MORE ON LIGHT BULB RESISTORS

By using the formula $R = E^2/W$, you can calculate the "hot" resistance of ordinary electric light bulbs. (See page 54, June 1957 issue.) The series resistance of some common wattage bulbs is given in the following table. —*C. C. D.*

Wattage	*Resistance*	*Wattage*	*Resistance*
6	2280	40	343
7.5	1825	50	274
10	1370	60	221
15	912	75	182
25	547	100	137

PILL BOTTLE COIL FORM

Try plastic pill bottles as coil form sources. You'll find the plastic is low-loss

enough for most coils and that the cap provides a convenient means of mounting. If you fasten the cap to the chassis by a

8 reasons why the world's most respected name in communications is hallicrafters

model S-38D $49.95

Wonderful starting point for the new amateur or short-wave listener. Same meticulous engineering found in all Hallicrafters equipment—at down to earth prices. Coverage: standard broadcast from 540-1650 kc. plus 3 short wave bands from 1650 kc. to 32 Mc.

model S-53A $89.95

Has easy-read overseas dial with international stations indicated. Electrical bandspread and logging scale. Complete with 5 in. speaker, headphone jacks plus phono-jack. Two stages of i.f. Coverage: standard broadcast from 540-1630 kc. plus four SW bands over 2.5—31 and 48—54.5 Mc.

model S-85, S-86 $119.95

A superb receiver that pulls them in on 10, 11, 15, 20, 40 and 80 meter amateur bands. Over 1000° calibrated bandspread gives better selectivity on large easy-to-read dial. Features separate tuning condenser and built-in PM 5" speaker. Coverage: Broadcast band 540-1680 kc. plus three S/W bands 1680 kc—34 Mc. S-85 AC, S-86 AC-DC.

model S-94, S-95 $59.95

Advanced models that bring in emergency radio, police and fire calls. Newly engineered FM chassis provides low frequency drift and low noise figure. Modern styling with simplified control gives easy operating. Coverage: S-94—30 to 50 Mc; S-95—152 to 173 Mc.

model SX-99 $149.95

The best at its price with all features demanded by DX enthusiast. Has "S" meter, separate bandspread tuning condenser, crystal filter and antenna trimmer. Easy-read dial has over 1000° calibrated bandspread through 10, 11, 15, 20, 40, and 80 meter amateur bands. Coverage: standard broadcast 540-1680 kc. plus three Short-Wave bands 1680 kc-34 Mc.

model S-102, S-106 $59.95

The only inexpensive complete receivers for 2 and 6 meter bands. New models with all of Hallicrafters famous engineering. Have 7 tubes with rectifiers, built-in 5" PM speaker, low frequency drift, compact bandspread design, phone jacks. Coverage: S-102—143 to 149 Mc. in 2 meter band; S-106—49 to 55 Mc. in 6 meter band.

model SX-104, SX-105 $89.95

Two new high frequency crystal controlled/tunable receivers at low cost. First time available on single band receiver. Ideal for monitoring government marine, fire, police and other emergency frequencies. Coverage: SX-104—30 to 50 Mc.; SX-105—152 to 173 Mc.

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Globe Chief 90

A completely bandswitching, 90 watt transmitter for 10-160M.

Here's a compact, 8x14x8", sturdy rig with well-filtered, built-in power supply. Pi-network matches most antennas from 52-600 ohms. Modified grid-block keying is employed for maximum safety. Has provisions for VFO input and operation. Kit form includes complete manual and all tubes and parts. Meter and cabinet carefully shielded for reduction of unwanted TVI.

Net: $67.50 Kit: $54.95

Just $6.75 Down
$5.47 per mo.

Globe Scout 680

65 watts CW; 50 watts on fone, plate modulated.

A compact, self-contained, bandswitching transmitter for operation of the 6 through 80 meter bands, with built-in power supply. High level modulation is maintained. TVI-suppressed cabinet. Pi-network output on 10-80M; link-coupled on 6M, matching into low impedance beams. New type, shielded meter. Globe Scout 66 is identical, except bandswitching 10-160M. Size: 8x14x8".

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Kit: $84.95

66 Wired: $109.95

$10.00 Down
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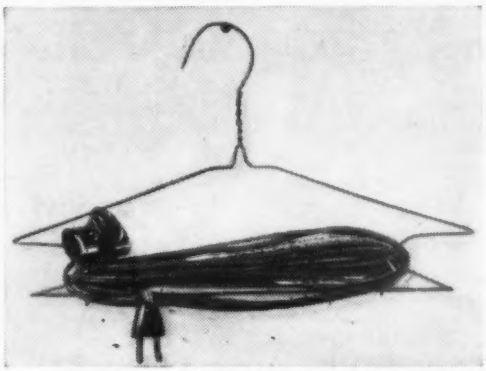
Tips

(*Continued from page* 36)

machine screw, the finished coil can be simply snapped into place. —*W. B. R.*

CLOTHES HANGER HOLDS WIRE

Storing extension wire is a cinch if you wind it on an altered clothes hanger. Convert the hanger into a reel by bending in the sides. Hang on a nail or in the clothes closet. —*K. M.*

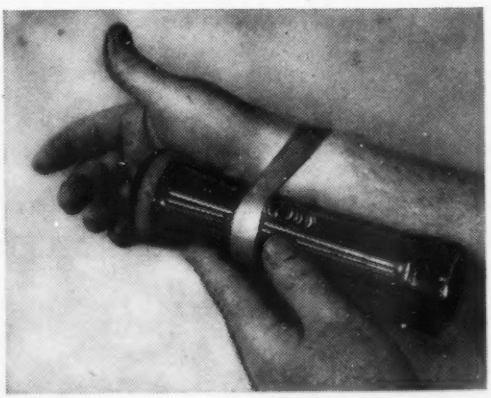


SPEAKER CONE REPAIR HINT

Have you ever found it difficult to repair a torn speaker cone successfully? The reason may be the use of ordinary cement, which contracts when it dries. This causes the speaker cone to warp, and the voice coil will frequently be displaced enough for it to rub the pole pieces. By using rubber cement for repairs, this possibility can be avoided. Even when dry, rubber cement remains flexible. —*J. A. C.*

HANDY LIGHT HELD TO WRIST

For poking around in dark places inside radio consoles or hi-fi cabinets, give your hands a built-in light. Strap a flashlight (either standard or penlite size) to your wrist with a wide rubber band. Both hands will be free for work and the light always directed where and when needed. —*K. M.*



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"ELECTRICITY AND ELECTRONICS—BASIC" by William B. Steinberg and Walter B. Ford. Published by American Technical Society, 848 East 58th St., Chicago 37, Ill. 235 pages. Hard cover. $4.50.

As the title states, this is a *basic* book; it might even seem *too* basic to the average P.E. reader. However, although most of us are familiar with tubes and transistors, we are apt to hesitate a bit when someone asks: "Well, just how is electricity *made* anyway?" Chapters such as those on generation and transmission of power will answer that question—and many others. Written in a simple, concise and down-to-earth way, the book includes some small construction projects, none of which would be difficult for the P.E. reader.

Recommended: for newcomers to electronics and for the old-timers wanting a quick review.

"ADDITIONAL 1957 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd., Highland Pk., Ill. 192 pages. Paper bound. $3.00.

The most recent of an extended series of publications, Beitman's new compilation includes service data from A (Admiral) to Z (Zenith). Relying on factory information, the new volume contains a cross section of the most popular of the *late* 1957 TV receivers and is meant to supplement, not replace, the earlier 1957 edition.

Recommended: to the TV serviceman and technician, who will find it an inexpensive means of keeping abreast of the latest in television circuitry.

"MASTER INDEX to Supreme Publications Most-Often-Needed Television and Radio Servicing Information." Published by Supreme Publications, Highland Park, Ill. 48 pages. Soft cover. 25 cents.

This handy booklet contains a complete cross-index of the Supreme manuals. Listing all radio and TV material from 1948 through 1957, the Master Index provides direct reference to the volume and page where needed material can be found. —30—

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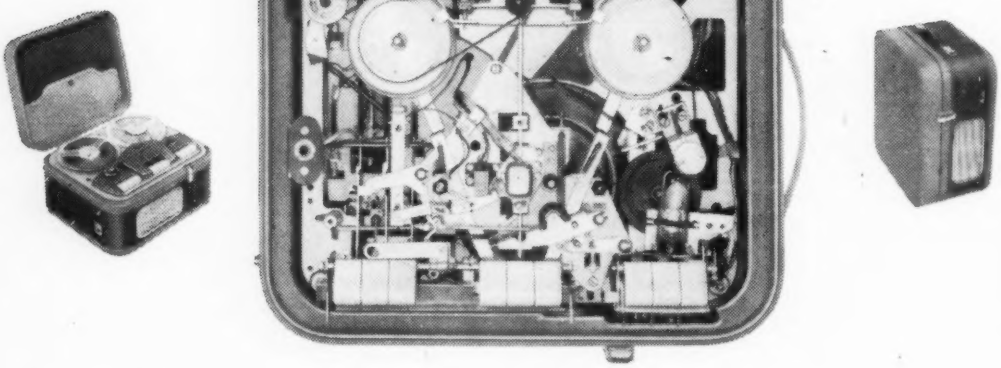

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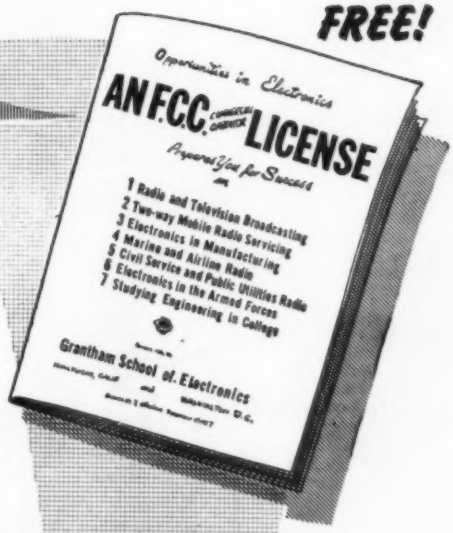
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Paul Schuett, 1314 20th Ave., Longview, Wn.	1st	10
Robert Todd, 216 West End Ave. Cambridge, Md.	1st	13
Dan Breeca, Station KOVE, Lander, Wyo.	1st	12
Joe C. Davis, Station WABO, Waynesboro, Miss.	1st	11
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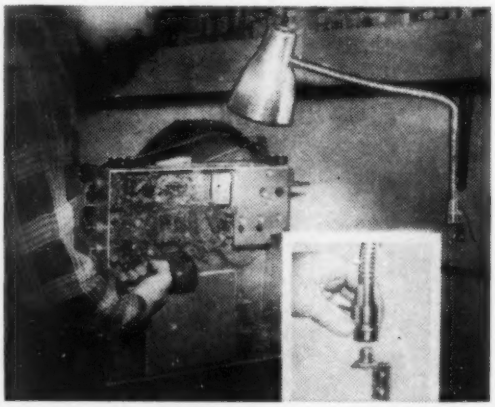

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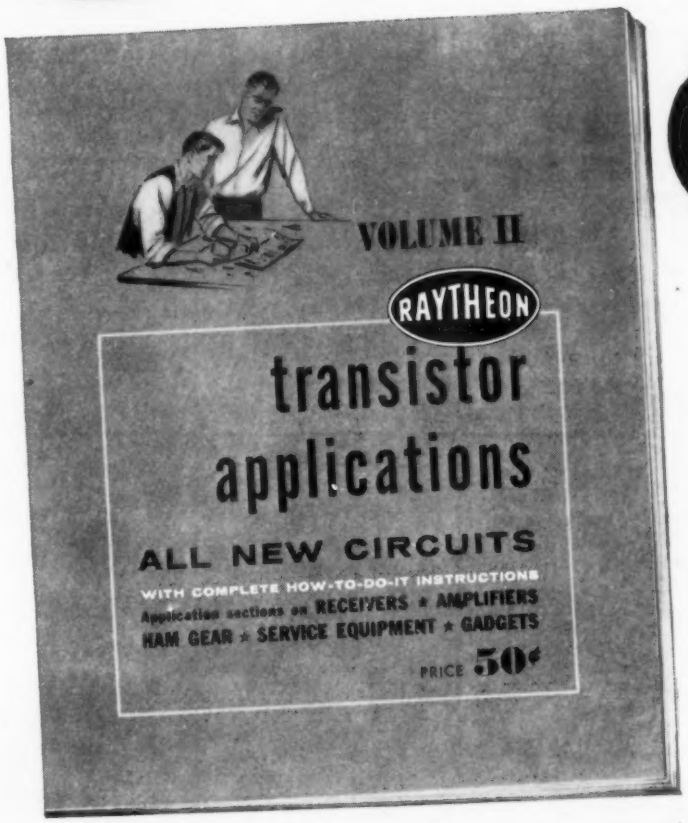

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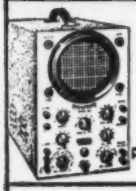

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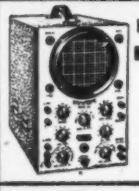

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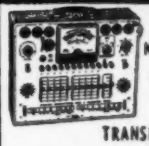

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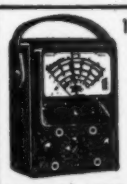

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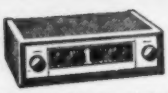

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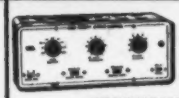

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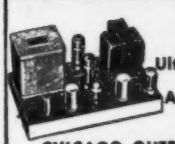

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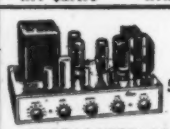

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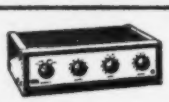

NEW! 12-WATT Williamson-type INTEGRATED AMPLIFIER #HF12
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Will There Be Another "ANDREA DORIA"?

Is the false security of radar to blame for ship collisions?

THE RIPPING CRASH as the "Stockholm" tore into the side of the "Andrea Doria" last year cracked wide open not only the unfortunate vessel but also the smug belief that sea disasters were a thing of the past. Fifty deaths totted up after the sea had closed over the speedy Italian liner were a grim punctuation mark to the question beneath the headlines:

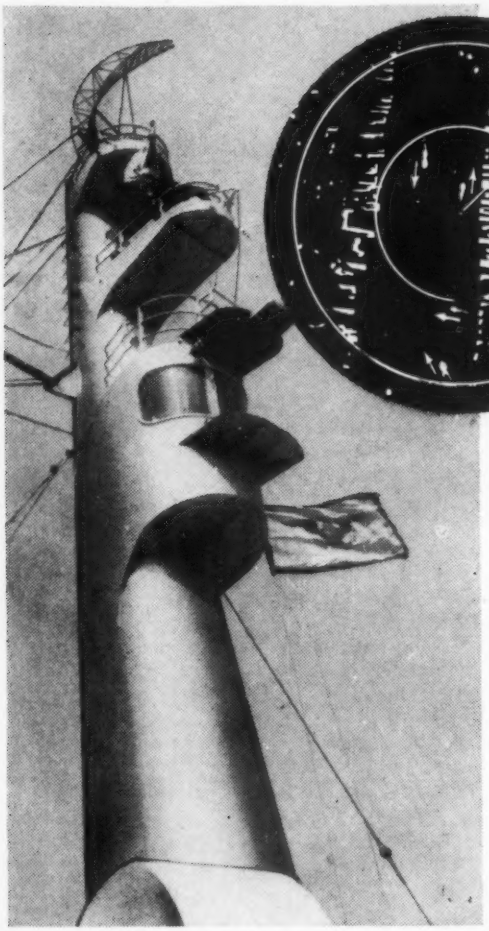
"Has radar really made shipping safe?"

The answer comes as a surprise: "No!"

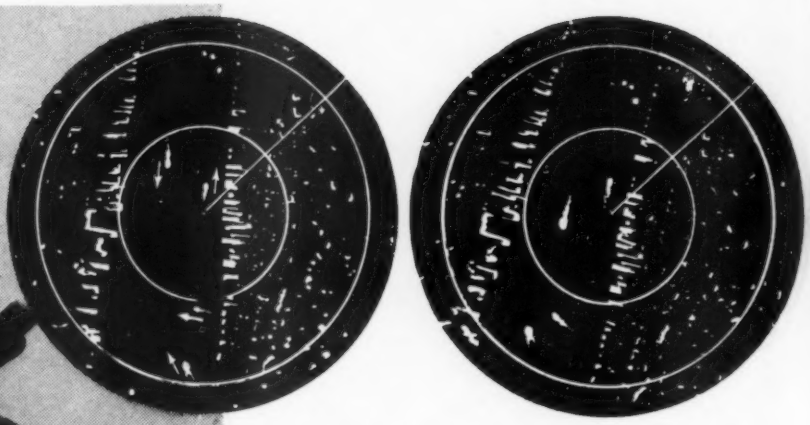
A quick look at figures supplied by the Coast Guard for the past three available years shows a

By MIKE BIENSTOCK

Wide World Photos



Modern radar installation on world's fastest liner, the S.S. "United States," is considered tops.



Sample pictures of true-tracking radar. Scope at left (with artist's arrows) shows picture two minutes earlier than the one at right. Comet-like tails indicate direction of vessels, easing plotting job.

steady, high toll of ship casualties by collision: 263 in 1954; 244 in 1955; and 279 in 1956. Unfortunately, there is no accurate breakdown of the number of ships which carried radar, but the Coast Guard sifted the 1951 figures and got some interesting results. Of the 182 collisions involving ships of over 180 gross tons, *almost half*—or a total of 90—involved vessels which carried radar. And of that figure, when the radar was in active use, under bad visibility conditions, the Coast Guard tagged radar as being a definite factor in 42 cases.

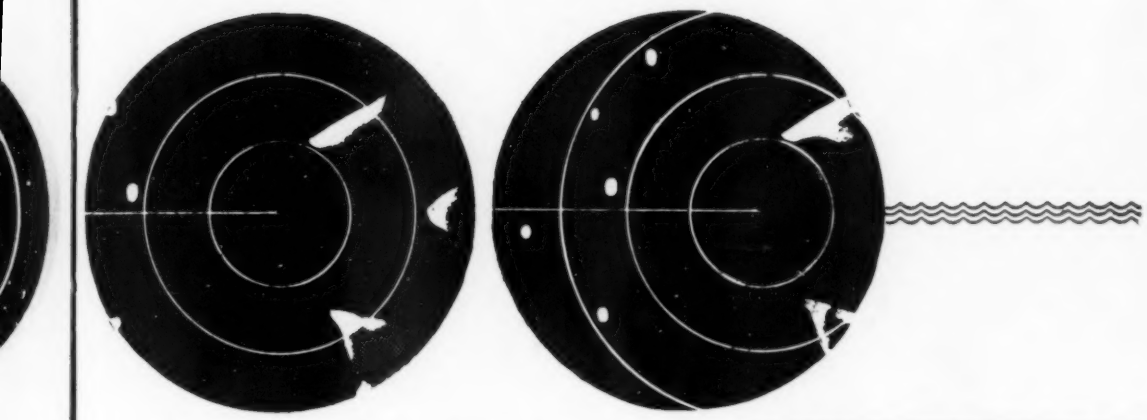
Is Radar Responsible? Now, of course, the specific question is: In what way was the radar responsible for the accidents? The answer seems to be that the blame falls not so much on radar itself, but on the human factors involved in use of the equipment.

Actually, there are two reasons for radar's "deficiency," as sea captains are quick to point out—off the record. First, there is the tendency of men on ships equipped with radar to relax and let radar "do the work." But that, it was noted, is not possible. Radar is only an adjunct to good seamanship—it can't take the place of careful, competent work on the bridge.

As an example, more than one passenger, home from an ocean voyage, has pointed out that there was no perceptible change in speed during fog or low visibility. Although ship owners claim that their standing orders call for complete obedience to international rules of navigation, more than one skipper has admitted that there are bonuses awaiting them if they bring in the ship within a half hour or so of schedule, and that there is a distinct possibility of demotion to a lesser ship if they're late too often.

The second reason lies in the use of the radar itself. Conventional radar shows only the relative or apparent motion of objects in relation to each other, with the "own ship," the vessel from which the signal is sent, stationary in the center. This means that even the buoys and nearby landmarks appear to be moving, while ships which seem to be moving in one

Diagram at right illustrates how radar works. The "own ship" sends out a pulse which travels at the speed of light, 186,000 miles a second, or 1 mile in 1/186,000 of a second. If the target is five miles away, it would take 5/186,000 of a second for the pulse to get there, and the same time for it to come back. On the scope it would show as five miles. Actually, the pulse would come back to the same antenna, but for purposes of clarity, this was not shown in the sketch.



These traces indicate how off-center radar works. At left, normal scope, with ship at center and land masses, of no value, intruding. At right, "own ship" has been shifted and more water is shown.

direction may actually be heading in a different direction.

With such a system, it is necessary to plot each object on a chart to determine its actual position. It can easily be seen that if the man on the bridge makes a mistake in plotting, or if he has too many "blips" to plot at one time, the ship may be in danger of collision. Investigations of collisions have more than once placed the blame on faulty plotting, as well as on "radar hypnotism"—when the operator became almost literally mesmerized watching the scope.

Human Nature at Fault. Human nature being what it is, it will probably be next to impossible to make all sailors conform to the "rules of the road." But there are several new devices nearing the market which will make it far simpler for the radar man to keep his head above water, and his vessel, too.

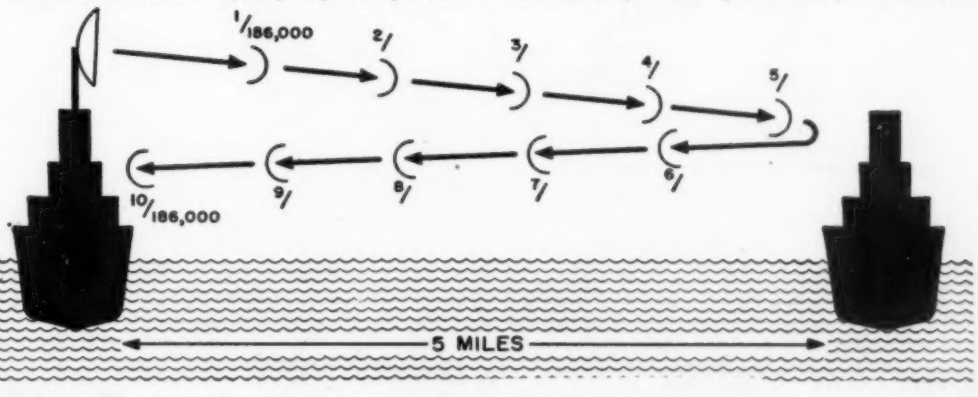
Both an American and an English firm have, within the past few months, unveiled "true-tracking" radar, an adaptation of conventional radar. Sperry Gyroscope Co. and Decca Radar, Inc. will shortly market devices that will show all objects which are actually moving as being in motion

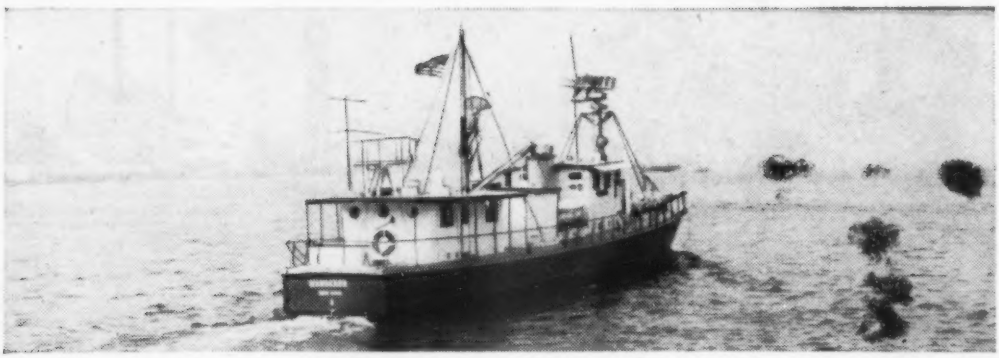
HOW RADAR WORKS

Radar is like a man standing in front of a mountain. If he yells and—with a stop watch—checks how long it takes the echo to bounce back to him, he can tell how far away the mountain is. For instance, if it takes two seconds, he knows it's about 1100 feet away. How come? Well, since it takes about one second for sound to travel 1100 feet at sea level, it would take two seconds for the round trip. If it took 10 seconds, he would know that the mountain was about a mile away, since sound travels about a mile in five seconds and it would need twice that time for the round trip.

The "yell" in radar is actually a very, very short burst of high-frequency radio waves pointed toward the mountain, or any other "target," by a highly directional antenna. When the electromagnetic burst, traveling at about 186,000 miles a second, hits the target, it bounces back, hits the same antenna, and appears as a "blip" of light on the radar screen. The distance away from the center of the screen is proportional to the distance from the target. The receiver does the work of calculating this distance electronically, without a stop watch.

Therefore, if the target is one mile away, it will take 1/186,000 of a second for the wave to get there, and another 1/186,000 of a second to get back. So, if the pulse comes back 2/186,000 of a second after it is sent out, the set "knows" that the target is one mile away, and it puts the "blip" at the one-mile-mark on the radar screen. At the same time, the radar antenna turns constantly, sending out these signals in all directions, so that it is continually "painting" pictures on the scope of what the antenna "sees" at various distances all around.





Sperry's "Wanderer," former Navy vessel, is used as proving ground for new radar installations.

while stationary objects will be motionless.

By setting the ship's course and speed into a small computer attachment, the radarscope will show, in effect, an "aerial motion picture" of ships within range of the scanner. In a panoramic presentation, moving objects, including the "own ship," will appear in perspective as moving blips of light with small comet-like tails to show course of travel. Although this projection will not completely eliminate plotting, it at least will tell the navigator exactly which ships present a collision course.

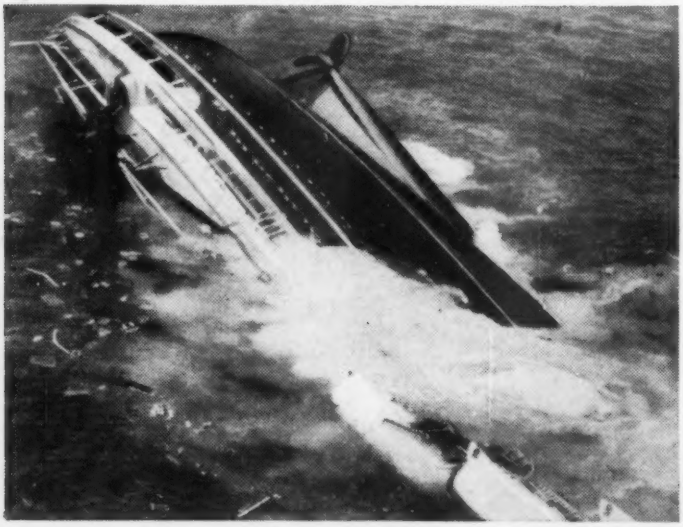
As an adjunct to Sperry's true-tracking device, the company also can incorporate off-center radar, which allows the captain to position his "own ship" anywhere he wants to on the scope. In this way, if he is in harbor, for instance, he can put the ship at the point which eliminates most of the land masses and gives him more of the water on his scope.

Memory Tube Will Help. An additional development which is about to be introduced by Raytheon Manufacturing Co. goes one step further. It incorporates a "memory" tube which stores all the information and can automatically plot the movements of other ships. The skipper will be able to feed the data on his course and speed into the device and it will give an automatic answer relating his course and speed to other ships and objects. It will also store the data indefinitely so that he can check back whenever he wishes.

Actually, what Raytheon has done is put the memory tube between the receiver and the radarscope, so that everything the receiver "sees" is stored on the tube and can be presented on the scope as the observer wishes. And the actual track of other vessels may be recorded for the captain to watch. This would completely eliminate the necessity for hand-plotting even the few ships required in true-tracking.

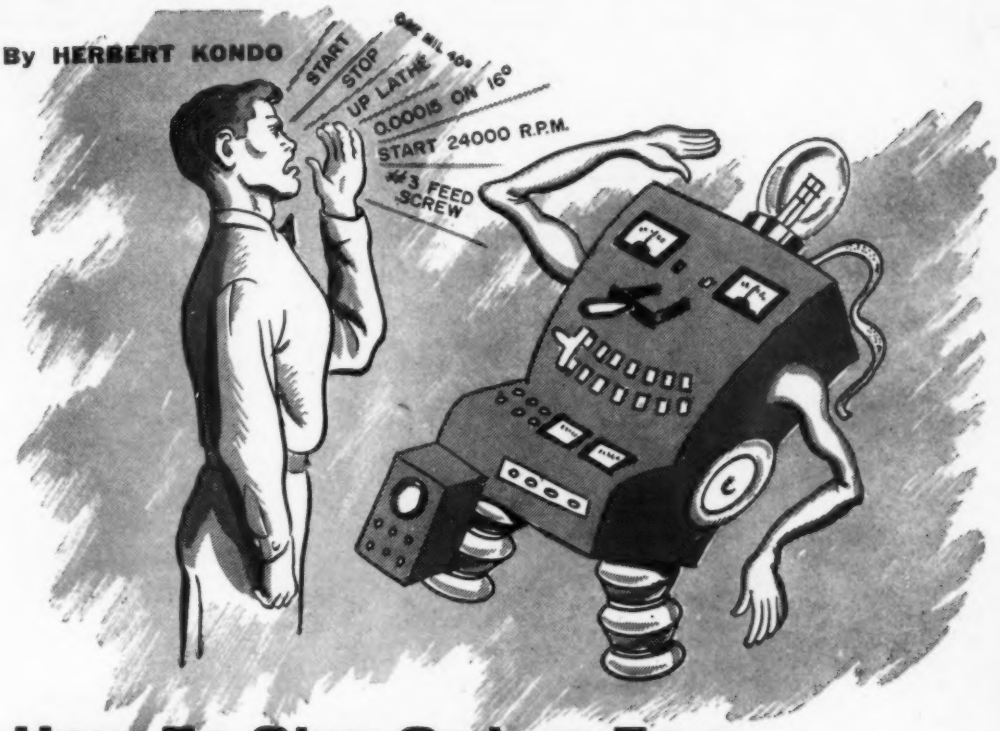
In other words, the "new" radar will be more automatic, easier to use, and undoubtedly will make navigation at sea much safer. However, radar will never be able to eliminate the human factor from seamanship — unless the electronic brain entirely takes over the running of our ships. Until that time, it will still be necessary for our seaman to remain constantly alert and obey the rules of the road, no matter how tempting it may be to rely on the "big eye" on the bridge. Otherwise, we may soon again hear those terrible words on the international distress band: "Mayday! Mayday! Sinking fast . . ." It may be another "Andrea Doria." -30-

Boston Traveler photo from Wide World



End of a gallant ship—the "Andrea Doria" sinks . . .

By HERBERT KONDO



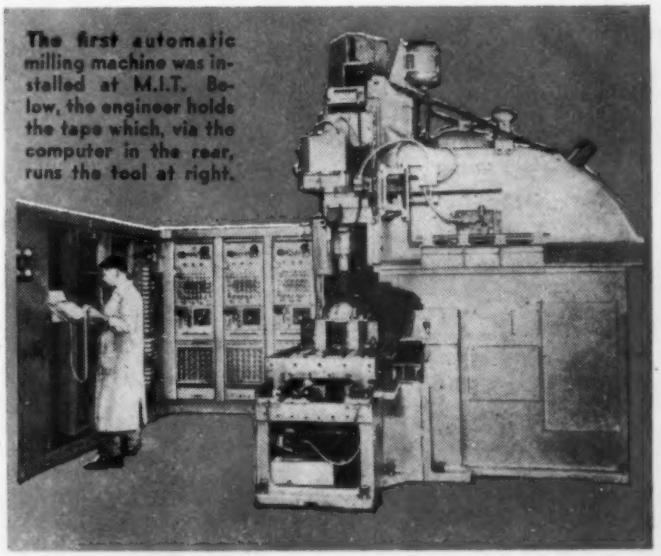
How To Give Orders To a MECHANICAL BRAIN

YELLING will get you nowhere—nor will psychology. Punching a computer in the nose may electrocute you. But punching tape works wonders.

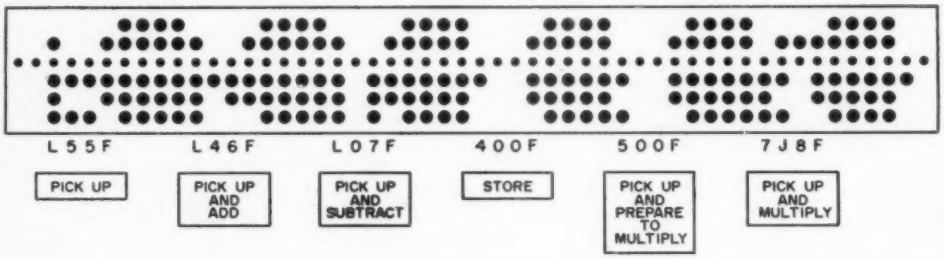
Communication between humans and machines is one of the main technical problems of our time. Our automatic machines are wonderful servants to our needs—far superior to the human slaves who accomplished the technical feats of antiquity, such as building the pyramids or the Great Wall of China. Our machine servants make far more complicated structures. But these metal robots are strangers among their flesh-and-blood masters, and they don't understand human language.

Machine "Shop-Talk." To give orders to the computers, which act as a sort of brain to automatic machines, the orders must be translated from human language into machine symbols, which form a code for the commands.

The process of translating the orders we want to give into the machine "lingo" is called "programming." In one type of program, the orders are in a punched pattern



The first automatic milling machine was installed at M.I.T. Below, the engineer holds the tape which, via the computer in the rear, runs the tool at right.



Here's an actual punched tape that gives orders to a mechanical brain. The brain's name is ILLIAC and it lives at the University of Illinois.

The holes are punched in vertical columns, and under certain columns you can see a number or a letter. Each number and letter is called a *digit*. On the tape above, there are six sets of four digits.

Each block of four digits is an order telling the mechanical brain to do something. So let's take a closer look at a sample block; take the second one, **L46F**.

The first two digits order the brain to do a specific job, which is printed below the block. In **L46F**, the first two digits are **L4**, a combination which tells the brain to pick up a certain number and add it to another one. Which number should it pick up?

That's where the third digit comes in; it refers to a particular *permanent* storage compartment in the brain. In our example, the third digit is **6**, and that's the number of the compartment. The brain, then, is ordered to pick up the number it finds in the sixth permanent storage compartment and add that number to another one.

The last digit is **F**. It signals the end of the order; note that all of the blocks above end in **F**. Now we're ready for the complete order.

L55F. The first two digits simply mean "pick up." The third digit refers to the fifth permanent storage compartment. So right off the bat the brain is ordered to pick up the number in the fifth permanent storage compartment and put that number in a temporary storage called the *accumulator*. The accumulator, which is used in almost every step, will hold the number temporarily until the mechanical brain needs it.

L46F. "Pick up the number in compartment 6," the brain is now ordered, "and add it to the number you just put in the accumulator. Leave the result there."

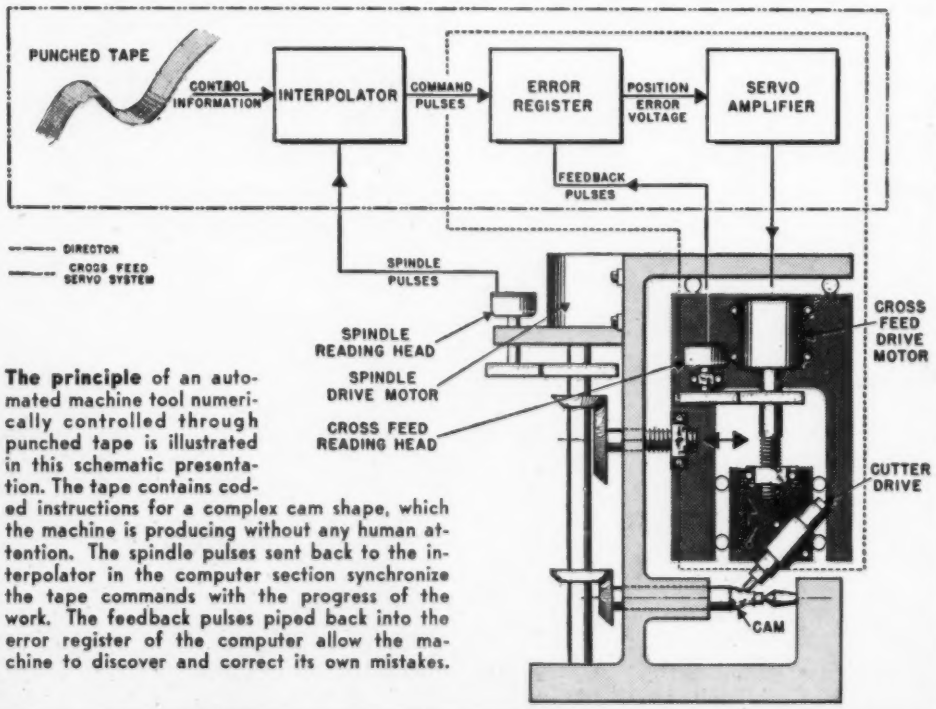
L07F. The brain picks up the number it finds in compartment 7, subtracts it from the total in the accumulator, and leaves the result there.

400F. The brain takes the number out of the accumulator and parks it in compartment O of the permanent storage.

500F. The brain is ordered to pick up the number it just stored away in compartment O and prepare to multiply it by another number.

7J8F. The brain pilfers a number from compartment 8 and multiplies it by the number in the previous step.

Simple, isn't it? And it took the mechanical brain less than 1/500th of a second to do all of it. What were you doing during that time? Loafing?



The principle of an automated machine tool numerically controlled through punched tape is illustrated in this schematic presentation. The tape contains coded instructions for a complex cam shape, which the machine is producing without any human attention. The spindle pulses sent back to the interpolator in the computer section synchronize the tape commands with the progress of the work. The feedback pulses piped back into the error register of the computer allow the machine to discover and correct its own mistakes.

Hole grinding is a cinch with this automatic Pratt & Whitney machine. Once the programmer (right) has punched the tape, the technician has threaded it into the computer (center), and the machinist has started the grinder (bottom), the whole thing runs by itself, boring cylinder blocks for aircraft engines at a Ford plant.

of holes in a paper tape. The tape is then fed into the computer, which "reads" these orders and does what we want it to do—cough up the answer to a monstrous mathematical problem, direct a machine to drill a hole in a certain place, or any one of innumerable preassigned tasks.

Hail to the Hole. Punching certain configurations of holes into tape is one of the most versatile coding methods presently available.

Among the recent applications of the punched tape is something called "numerical control," an important part of automation. Here's the gist of it: we first convert a blueprint into a set of numbers expressing the dimensions. Then we punch the numbers into a coded pattern on a paper tape. When fed into the computer, the tape sets off a corresponding series of electric pulses which direct the operation of a machine tool of some sort. The machine tool will precisely cut the part called for in the blueprint.

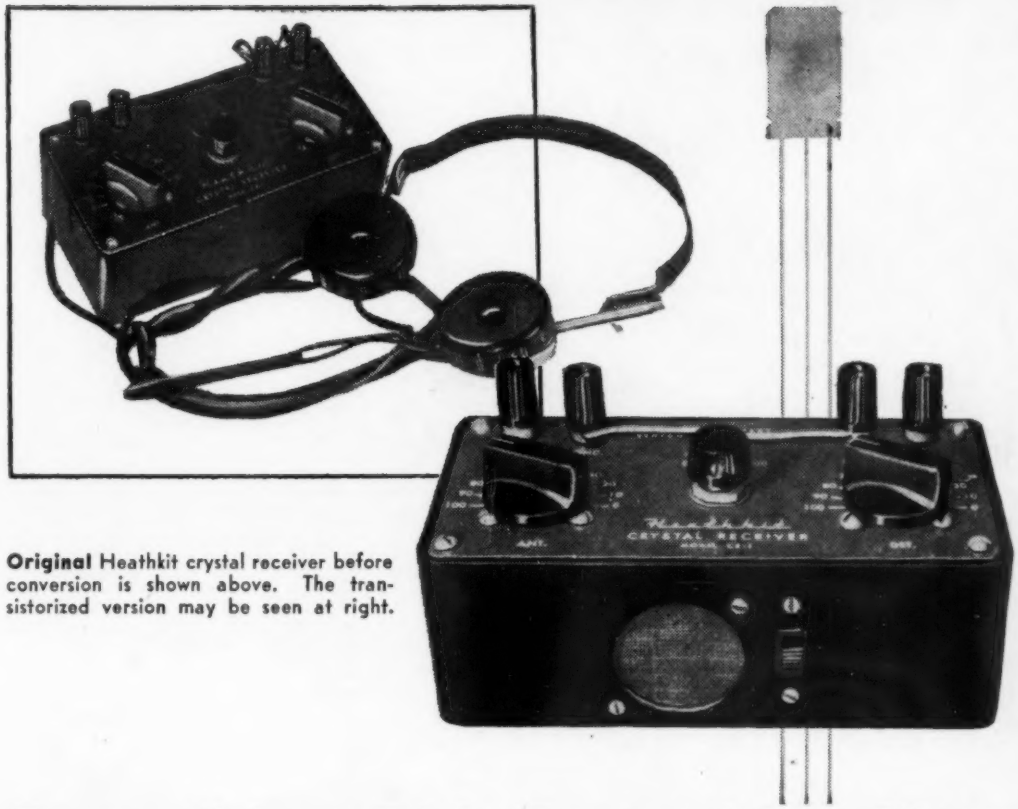
Money vs. Nerves. The automatic milling machine has a psychological advantage, too. When a machinist starts out with his piece of metal, it is worth a few dollars. Near the end of his work, the value of this piece of metal has climbed hundreds of dollars because of the work involved in it. The machinist is practically a nervous wreck as he starts to drill the final hole, and he could easily botch the job from tension and anxiety.

But if, instead of a human bundle of nerves, an electronic robot guides the machine, the process becomes immune to emotion; for the robot knows nothing of value—neither in dollars nor fear for the job. It "knows" only the blueprint dimensions of the part to be manufactured—nothing else. With so little "knowledge," it is impossible to become confused, to have conflicts, to make mistakes. The very stupidity of such a "mechanical brain" thus becomes a virtue. For robots, ignorance is bliss. That, after all, is why they are robots. Given intelligence, they

(*Continued on page* 120)

Getting the Message Over—Fast!

ONE of the biggest headaches of an army is communications. Determined not to be caught napping, our armed forces keep up constant research in every field of communications to make them faster, simpler and more efficient. Shown here are three of the latest developments. Above, two Signal Corpsmen test the newest facsimile set which can put a high-quality Polaroid photo in the hands of the command post miles away in five minutes. The Times Facsimile Corp. equipment fits easily into the back of a jeep, and can transmit 40 miles. Below, left, the Signal Corps has fitted its new helmet radio with silicon "solar batteries." Results are so promising that they're being considered for walkie-talkies. The clusters on the crown of the helmet charge four small nickel-cadmium storage batteries for peak current in the daytime and to power the set at night. A transistorized converter hikes the 4.5 volts to 50 volts. It weighs less than a pound. Below, right, the Marine Corps is getting effective point-to-point contact with this highly directional, egg-shaped antenna used with its new lightweight radio developed by Raytheon. The set can be carried by one man, and is ideal for use with troops landed by helicopter. It works in the super-high-frequency (microwave) band, and can be linked in chain fashion with other transmitters of the same type to relay a signal up to 40 miles. —30—



Original Heathkit crystal receiver before conversion is shown above. The transistorized version may be seen at right.

Something Old—Something New

How to convert a crystal set for transistorized loudspeaker operation

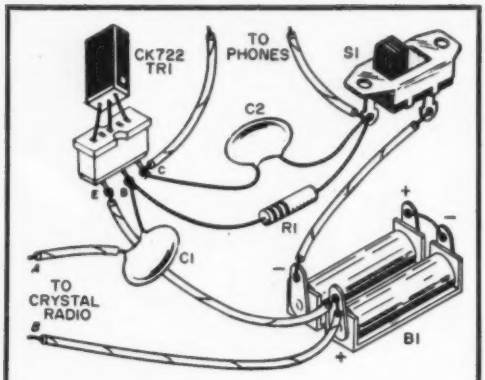
By HOWARD G. McENTEE

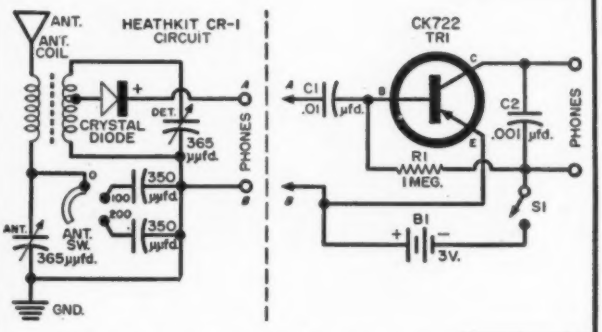
OUR TITLE refers not to the marriage superstition but rather to a trend in the electronics industry. The combining of the old and the new is now standard procedure. Ideas once consigned to the junk box are being dusted off and re-examined in the light of today's needs. Techniques are developed which allow formerly impractical contrivances to reappear in new, workable forms and products. The electrostatic tweeter, the crystal detector, and even the ever-present magnetic phonograph pickup are "modern" devices which have been with us for 30 years or more.

So, in line with the times, we are presenting to you a little receiver using one of the oldest of electronic components—the crystal detector, and one of the newest—the transistor. By employing a well-designed crystal receiver kit—the Heathkit Model CR-1—as a base of operation, you'll find that you have plenty of room inside for all the added components, *including* a tiny loudspeaker. And the finished receiver is just as handy to carry about as was the unconverted CR-1.

If you're starting from scratch, the receiver can be assembled just as called for in the Heathkit instructions. Hook it up to an antenna and ground, and check the volume on a local station. This will give you a "standard" against which to compare the amplification achieved by adding the transistors. You have a choice of two transistor amplifier circuits. The first, a single-stage job, is used with headphones, while the second is a two-stager that will permit loudspeaker operation on strong local stations.

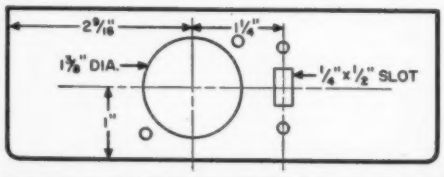
One-Stage Amplifier. All parts of the amplifier are fastened to a single strip of perforated phenolic, 5″x2″x1/16″ thick, the assembly being held to the underside of the two variable capacitors in the receiver with cellophane tape. (It may be necessary to





B1—Two 1½-volt cells (Eveready #912, Burgess #7 or equivalent)
C1—0.01-μfd. ceramic disc capacitor
C2—0.001-μfd. ceramic disc capacitor
R1—1-megohm, ½-watt carbon resistor
S1—S.p.s.t. slide switch
TR1—CK722 transistor (Raytheon)
1—Two-cell battery clip (Lafayette MS-138)
1—Sheet of perforated phenolic (Lafayette MS-305)

Pictorial and schematic above are of the original Heathkit circuit and the one-stage transistor amplifier that is added to it. The antenna coil is available only in the kit. Cabinet layout below shows the cutouts to be made in the CR-1 cabinet. If the one-transistor job is used, only the switch cutout is needed.



reposition the antenna coil closer to the panel to avoid shorting to the phenolic-mounted components.) At one end of the strip, mount a dual holder for the two-cell battery (*B1*) using a pair of *6-32* nuts and bolts. Capacitor *C1*, resistor *R1* and transistor *TR1* are held to the strip by "lacing" their leads through appropriate holes.

In order to use the same binding posts for the transistor receiver as were employed in the original set, it is necessary to insulate one more of them from the metal panel. You will find one of the *Phones* jacks insulated from the panel and one grounded. Using shoulder washers, "unground" the grounded one. Tape the transistor amplifier assembly in place and connect the end of the crystal diode (which originally went to one phone post) to the free end of *C1*. Run the lead from the coil and the 365-μμfd. fixed capacitor (which originally connected to the grounded phone post) over to the *Gnd.* lug. To this same lug goes the lower lead (CK722 emitter and battery plus) as shown on the schematic diagram at left. A hole should be cut in the Bakelite case for the on-off switch, according to the dimensional sketch shown below, left.

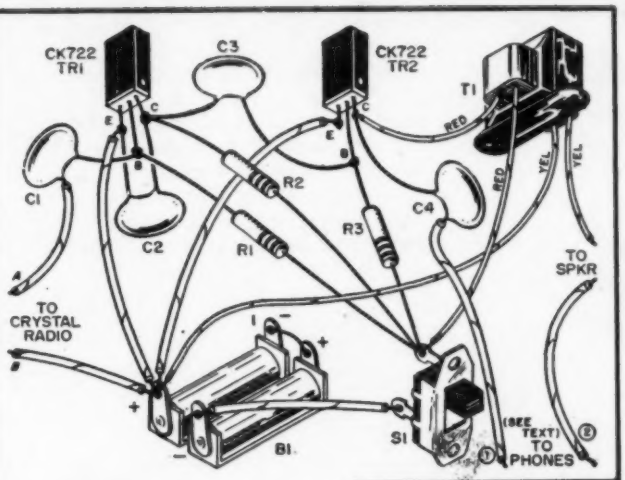
The single-stage amplifier will give good results with the lowest cost transistors, and can use most *p-n-p* types. For *n-p-n's*, reverse the leads to *B1* (plus to collector). As only about 0.2-0.4 ma. is drawn from the cells, they will last for months.

Two-Stage Amplifier. For loudspeaker use, it is necessary to add another transistor stage. The first stage is almost exactly like the one already described, except that a fixed resistor (*R2*) has been substituted for the headphones. All parts for this amplifier can be mounted on the same perforated 5″x2″x1/16″ plate and, as with the single-stage amplifier, parts layout is not critical. Again, all parts with wire leads are fastened by simply running their leads through the perforations.

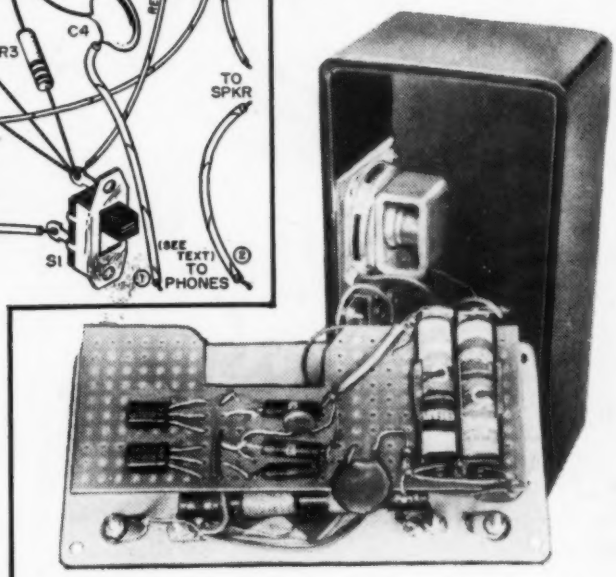
Cut a speaker hole to the dimensions shown. Be sure to place it accurately, so that it won't snag any of the chassis parts. A small square of wire screening or other "grille cover" should be mounted inside the speaker cutout, to protect the delicate cone from damage. The speaker hole shown was made with an Arco rotary hacksaw, but a small circle of drill holes may be made if you don't have such a saw, and you can fill the 1⅜″ area with holes or file out the entire area to make one large hole.

While the two-stage job is intended to be a "loudspeaker receiver," some stations won't have enough volume for speaker use; the phone binding posts are therefore connected so that headphones may still be employed when required. For loudspeaker use, connect a wire from post *2* to the *Gnd.* post on the receiver panel. For headphone use, remove this jumper (which will cut out the speaker) and connect your phones.

With this amplifier, it is actually possible to overload the second transistor (*TR2*) with loud signals. This does no damage, but will result in poor tone quality. Such over-

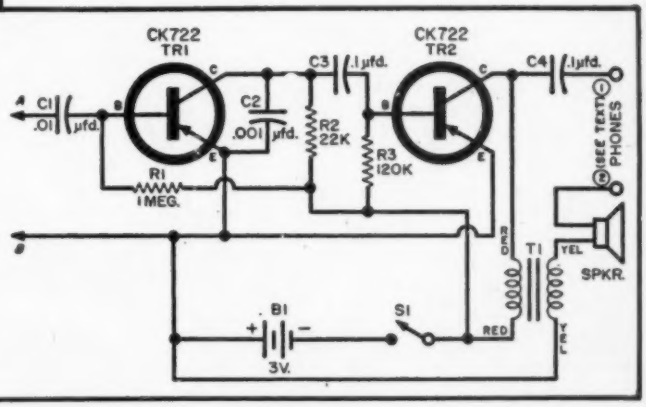


Miniature speaker is mounted in cabinet as shown below. Phenolic panel should be cut out as shown to enable it to clear the speaker magnet when the front panel is installed.



B1—Two 1½-volt cells (Eveready #912 or Burgess #7)
C1—0.01-μfd. ceramic disc capacitor
C2—0.001-μfd. ceramic capacitor
C3, C4—0.1-μfd. ceramic capacitor
R1—1-megohm, ½-watt carbon resistor
R2—22,000-ohm, ½-watt carbon resistor
R3—120,000-ohm, ½-watt carbon resistor
S1—S.p.s.t. slide switch
T1—Audio output transformer, 2000-ohm primary, 10-ohm secondary (Argonne AR-96)
TR1, TR2—CK722 transistor
SPKR.—1½" loudspeaker, 10 ohms impedance (Argonne AR-95)
1—Two-cell battery clip (Lafayette MS-138)
1—Sheet of perforated phenolic (Lafayette MS-305)

Two-stage amplifier is designed so that only a few components, the speaker and the transistor, need be added for conversion from the one-stage model. The components may have to be relocated as per the photograph above, right.

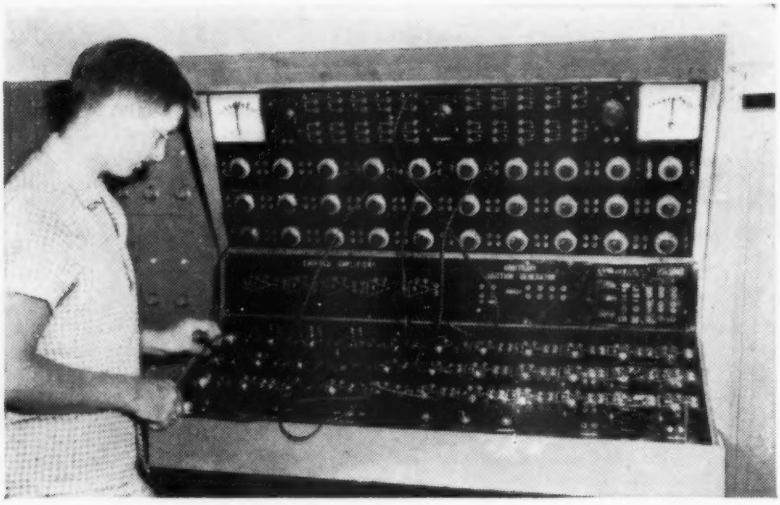


loading may be eliminated by detuning the *Ant.* capacitor slightly (turn it toward zero for less volume) with the *Ant.* switch set at zero. Even with both transistors in use, the current drain will be only about 1 ma.

Though designed especially to fit into the Heathkit CR-1 receiver cabinet, these little amplifiers can be used with any other crystal set with similar results.

For Improved Tone. Although very efficient for its size, the miniature speaker mounted in the Heathkit cabinet can't move enough air to enable reproduction of the lower frequencies. You can obtain really surprising results by connecting the CR-1 to a 6" or 8" speaker mounted in an appropriate baffle. The "Oval-Flex" described on page 109 of this issue might be ideal.

There are other tricks you can try with your modified CR-1. For example, you can use it as a tuner and feed it into an input of your hi-fi amplifier. It would be best to disconnect the CR-1's internal speaker by removing the jumper wire between post 2 and the ground post. Now connect a shielded lead between post 1 and ground and plug it into your tuner input. And for a *really* "wild" experiment, don't use your hi-fi amplifier—just try out the modified CR-1 with your living-room hi-fi speaker-system *directly*. —30—



Student at Arizona State College begins to work problem on "home-built" analog computer. Many of the parts were made by students. The "brain" is 6' long and 12' high, has a plotting board that resembles a telephone switchboard. Much of the design was done by one of the instructors.

Electronic Brain Goes to College

A home-built analog computer at Arizona State College is solving in a half-hour problems it would take a man months to figure out. Some of the parts were built by 14 students in the school's circuits course and their professors, others were supplied by interested firms. The machine will add or subtract any series of numbers, multiply or divide, raise numbers to related powers, extract roots, differentiate, integrate, solve simultaneous equations, or perform any combination of these functions. The students can set it up and get answers to most problems themselves.

Don't Get "Burned" on a "Hot" TV Set!

The recent death of a 6-year-old Chicago boy has thrown into sharp focus the need for safety redesign of a.c.-d.c. television receivers. The lad brushed against the metal stand holding the set at the moment he touched a metal kitchen cabinet. He was electrocuted instantly. The metal-cased receiver was found to be "hot" enough to light a 60-watt bulb. A screw from the chassis was said to be in contact with the metal case, and hence the safety precautions of the manufacturer were "short-circuited."

In an a.c.-d.c. receiver, one side of the a.c. line is connected directly to the chassis and it is vital that the conductive metal parts (chassis, control shafts, etc.) be isolated and insulated from the person operating the set. If the manufacturer had supplied a polarized plug, this fatal accident could have been avoided. Ideally, of course, such sets should be used with an isolation transformer. Also, the cabinet could be grounded to a water pipe or to the center screw of the power outlet, which should be grounded. In the latter case, if a potentially dangerous short occurred, the only risk would be a blown fuse.

Push-button construction work is on the way. A standard U.S. Army "Tournadozer" equipped with standard military radio equipment (above) can be put through its paces by helicopter or jeep with transmitter and special control box up to a distance of 15 miles. It's under test at Fort Belvoir, Va.

Subscription television—what it is and how it works

By MIKE BIENSTOCK
Associate Editor

WHAT IS THIS THING called pay-TV? More and more it's been in the news lately, and chances are that very soon the FCC will hand down a decision on whether to allow a public test or not. So let's examine it, take it apart and see what makes it tick.

Pay-TV (or subscription television, to use the technical term) is just what the name implies—television service for which the viewer pays rather than the sponsor. Without going into the name-calling aspects of the controversy, there are powerful elements opposed to the system, and equally powerful elements in favor of it. Therefore, the FCC—which has been examining all aspects of the situation for several years—has a ticklish decision to make.

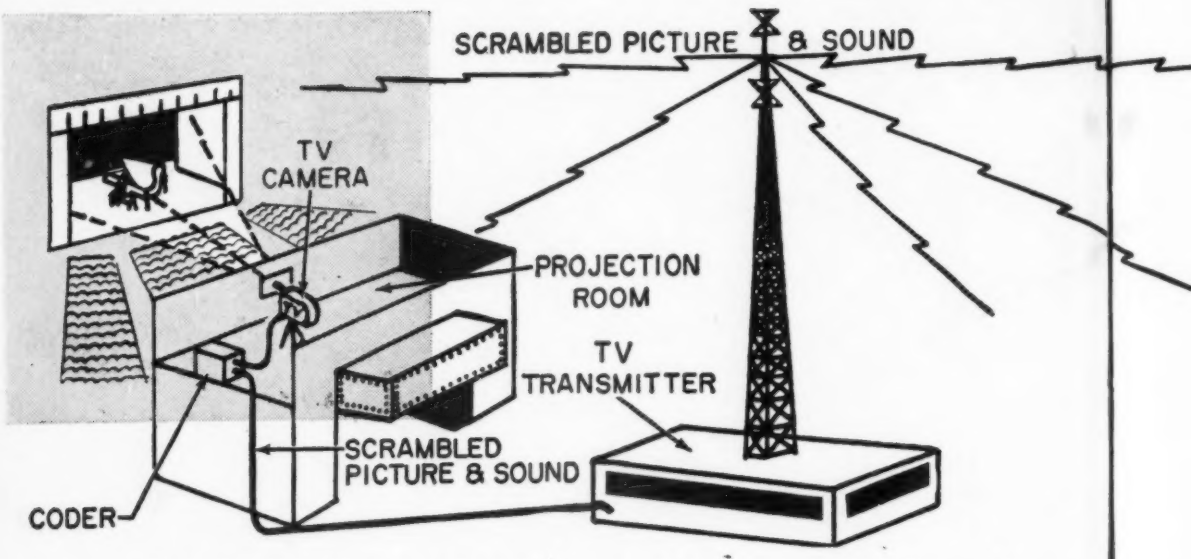
The system itself can be used in two ways: broadcast transmission on one or more channels, with the viewer choosing the program he wants to see and paying for it; or closed-circuit transmission, paid for on a program basis or by a monthly flat fee.

Each method has its proponents, but at the moment the FCC enters the case only in the broadcast aspect, since it has the power to regulate such transmission. It is possible that in the future the agency may rule that it has power over interstate closed-wire television also.

BROADCAST TRANSMISSION

The key to the broadcast transmission scheme, of course, is a means of preventing just anybody from receiving the programs. The three major firms in this field have all turned to coding (scrambling), which presents a problem.

If they scramble the picture and sound (they believe sound must be coded too, because they've found that people will just

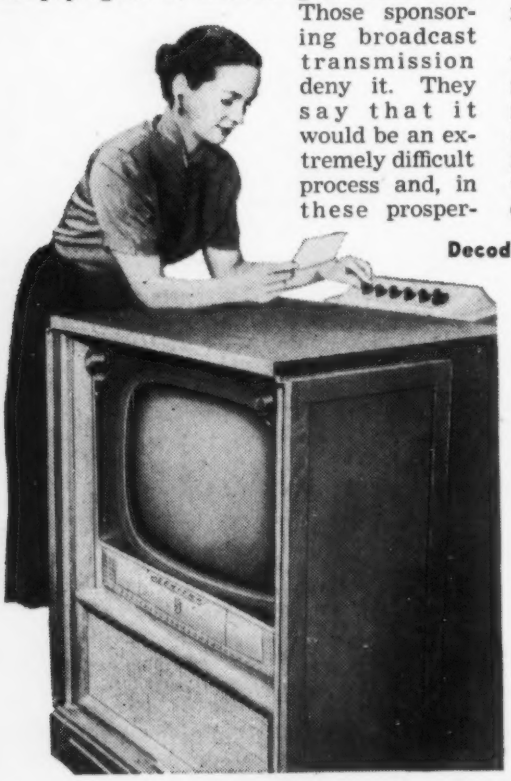


Basic operation of broadcast subscription TV is exactly the same as normal television. The big

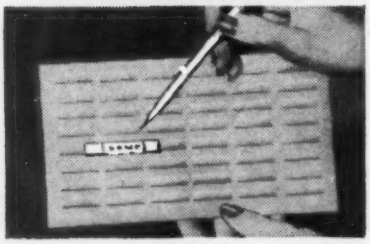
listen to the sound and enjoy it), there must be some way of unscrambling it. So, naturally, they will provide their customers with decoders. But there's the rub. Some people, principally the proponents of closed-circuit transmission, claim that any coded broadcast could be bootlegged (uncoded by those not paying for it) with the greatest of ease. Those sponsoring broadcast transmission deny it. They say that it would be an extremely difficult process and, in these prosperous times, wouldn't seem worth the work.

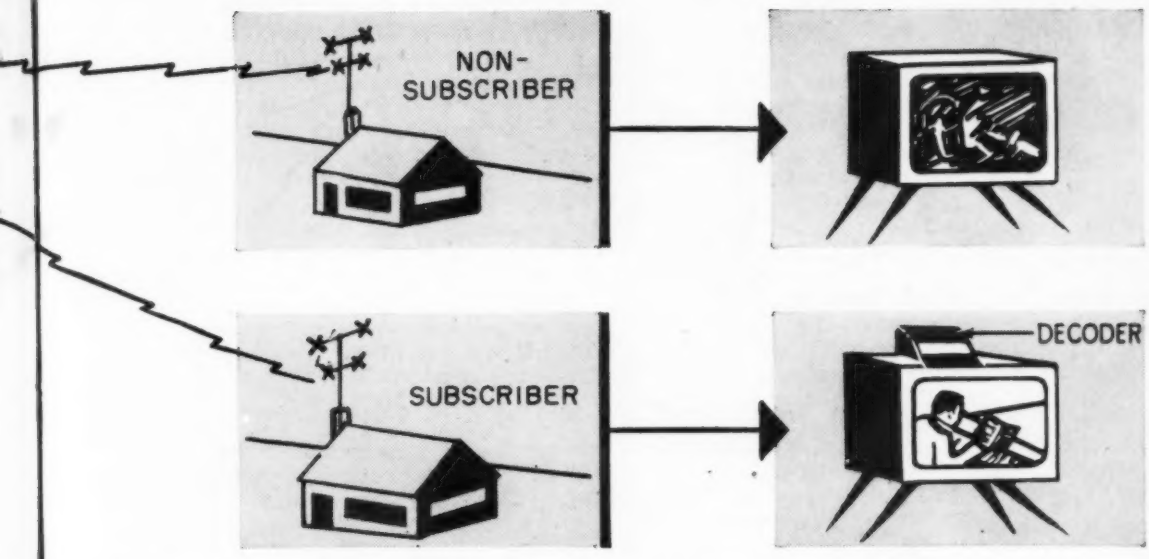
Scrambling. First let's examine scrambling. Generally, three types would be used, individually or in random order. One is coding by line groups, in which groups of lines are shifted in relation to each other, giving a Venetian blind effect whereby each of the "slats" forming the picture is moved in relation to the next.

Field coding is the second type, in which the two fields of the picture are shifted in relation to each other. The normal field results from the way the picture is "painted" on the tube. In the 525-line picture, first alternate lines are transmitted, then the lines in between, but in such rapid sequence that you "see" both fields. In cod-



Decoder used by Zenith has numbers set by knobs, obtained





difference is the insertion of a scrambler step before transmission and a decoder at the receiver.

ing the fields, the two sequences would be shifted out of relationship, so you would see a blurred series of images rather than a clear picture.

The third form is essentially the same as the first, except that instead of coding groups of lines a single line is shifted out of phase with the next. In addition to this, inversion of polarity is used just to confuse the picture. Here white would appear to be black, and black white.

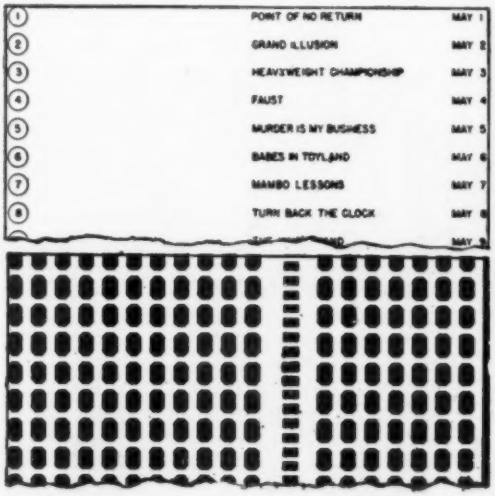
When all three types are used in random order, with reversal of polarity thrown in for good measure, the result is quite definitely impossible to make out.

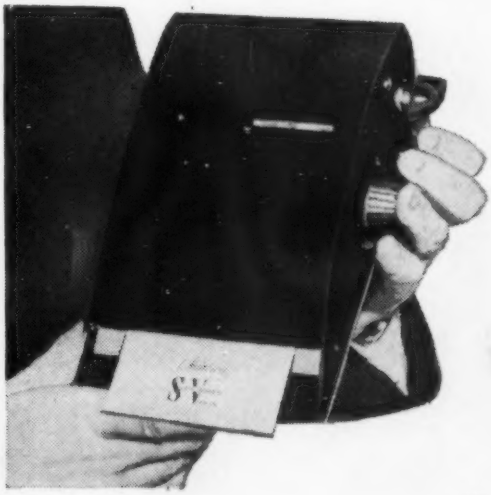
Decoding. The coded picture, to be viewed, must be decoded. There are three decoding systems currently taking the spotlight which are ready for action.

Skiatron uses a decoder which is keyed by a printed-circuit IBM-type card. The card is inserted and the viewer presses a button. The circuit is closed and the device automatically clears up the picture. At the same time, it punches the card as a record. At the end of a month, the card would be sent back, the total tallied, and the next month's card sent to the viewer.

Zenith uses a decoder on which five knobs can be turned to form a series of numbers. A punch-out card provided by the firm supplies the proper number for the day in question, and would work only for that decoder. Punched holes form the basis for

by punch-out card, while Skiatron's system (below) uses printed-circuit card inserted in decoder.


1 POINT OF NO RETURN MAY 1
2 GRAND ILLUSION MAY 2
3 HEAVYWEIGHT CHAMPIONSHIP MAY 3
4 FAUST MAY 4
5 MURDER IS MY BUSINESS MAY 5
6 BABES IN TOYLAND MAY 6
7 MAMBO LESSONS MAY 7
8 TURN BACK THE CLOCK MAY 8



billing. A small electronic computer is used to "devise" the numbers for each subscriber.

Paramount's Phonevision, which was originally conceived as a telephone transmission operation, has since switched to broadcast, but in this case, rather than numbers and cards, a coin box is used. When the proper number of coins has been deposited, the picture will be unscrambled.

CLOSED-CIRCUIT TRANSMISSION

If the FCC fails to approve tests of broadcast pay-TV, the industry will be forced to fall back on closed-circuit transmission. In this case, a huge wiring program would be entailed. While this might not be too costly for smaller towns and rural areas, it would involve considerable expense in metropolitan areas where telephone and utility wires are underground. On the West Coast, however, some communities—such as the city of Los Angeles—have most of their utility wires on poles above ground. This would simplify closed-wire installation to a tremendous degree.

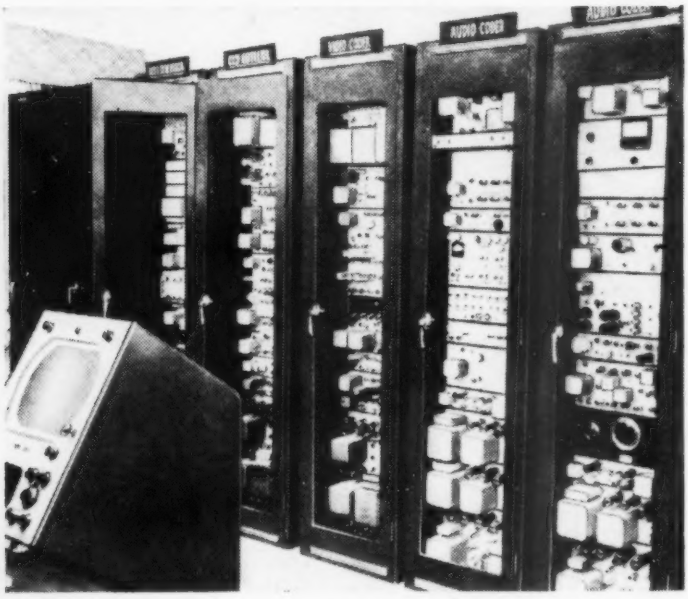
Skiatron has claimed to have developed a new light line which is inexpensive, yet would be able to carry three signals. Such a line would cut down costs tremendously. Otherwise, of course, coaxial cable would be used.

Jerrold, a firm which specializes in community antenna systems, claims that closed systems are the only practicable types for subscription television, since, the company says, it is simple to devise an unscrambler which would decode any picture. Jerrold stated before the FCC that it is prepared to file for a patent on such a device. Also, this firm points out that there are scores of communities already wired for master antenna systems, and calls for FCC-sponsored tests in such an area. It adds that there would be no problem of "bootlegging" the signal, since service would be supplied by simple switching as in a telephone office.

Jerrold is in the process of setting up such a system in Bartlesville, Okla., which will be run by a theater chain. Three channels will be available, one offering 13 first-run movies, another second-run pictures, and the third background music, news and time; for this entertainment package, the subscriber will pay $9.50 a month.

WHAT THE FUTURE HOLDS

Under both types of transmission, the programs are expected to be first-run movies, Broadway plays and musicals, sports, opera, symphonies and certain special events, as well as strictly educational programs.



Typical of encoding systems which will scramble picture and sound is this one used by Zenith. The monitor in front keeps continuous check on picture "quality." Although this is a rather elaborate setup, other coding installations are simpler. A closed-wire system would need no scrambling, since programs would be routed to customers by means of a switching system similar to one used for a telephone switchboard.

In some quarters this is seen as being the ruination of the movie industry, but others claim that it would be its salvation. Some say that to force the public to pay for a broadcast would violate the "freedom" of the air; others point out that the public is actually paying for commercial television now through buying the products of the firms that pay for the air time.

One thing is certain. In one way or another, there will be a form of pay-TV in the not-too-distant future. Whether you will be willing to pay from 25 cents to a dollar or more for such entertainment will be up to you to decide. But it will be there for you to make the choice. —30—

Battery-operated, this "portable" intercom is free from power line problems. It can be set up anywhere as a temporary or permanent communication center for the home or farm.

I Hear You Talkin'

Transistorized "portable" intercom features CBS-Hytron 2N255 power transistor

By LOUIS E. GARNER, JR.

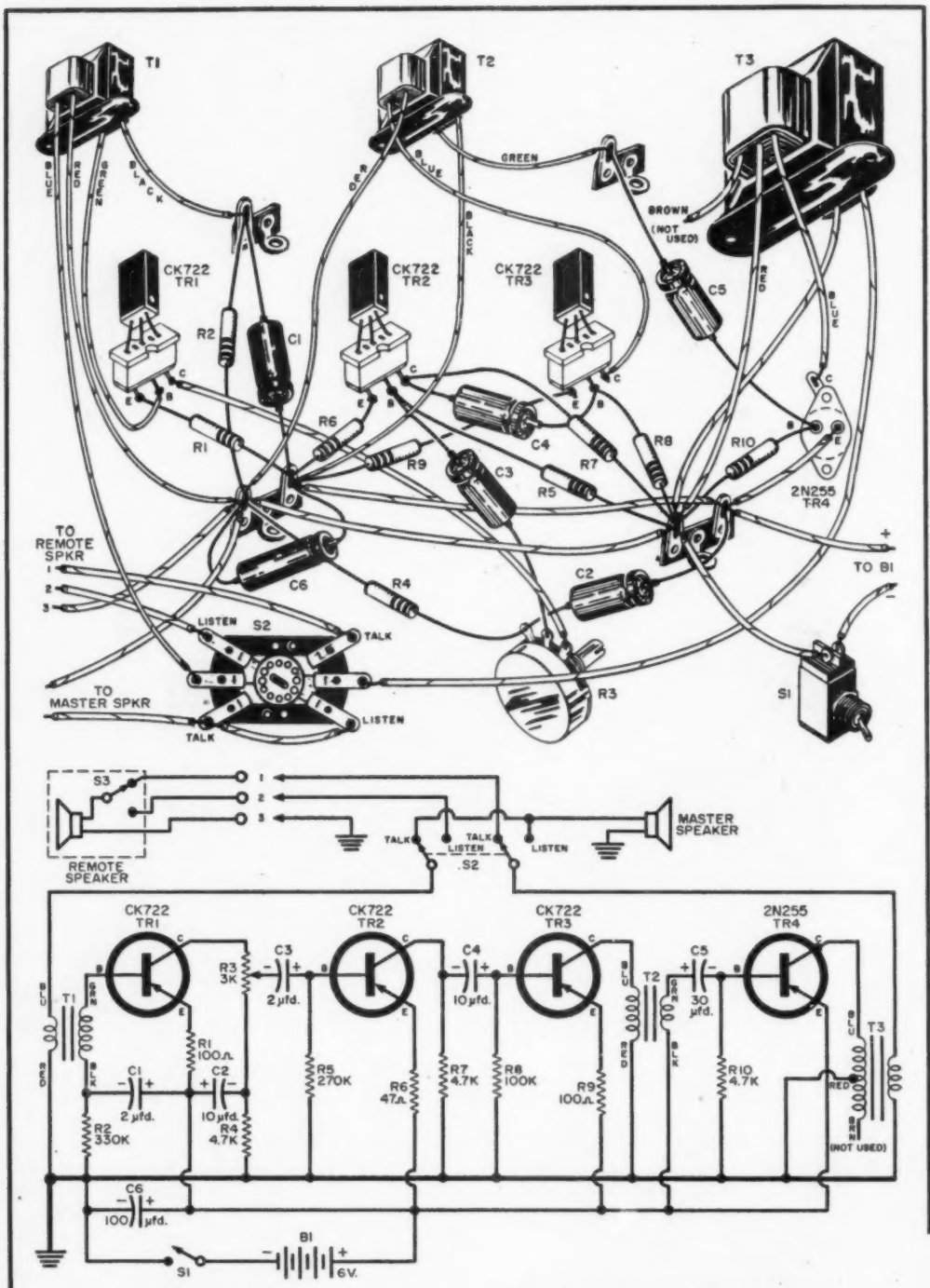
OUR EFFICIENT FRIEND, the transistor, is finding new employment opportunities daily. Anywhere that a low-noise, low-impedance, and low current-consuming amplifier is required, there you are apt to find one or more of these little fellows inquiring: "Gotta job for me? I'm light-weight, heavy-duty and willing to travel."

The home intercom system is a natural for "transistorization." By powering it from a 6-volt battery, the possibility of shock or power supply hum can be eliminated. This unit is designed around three old standbys (CK722's or equiv.) and a newer type 2N255 power transistor. The circuit is simple and you should have little difficulty either in assembling the components or raising the cash to buy them.

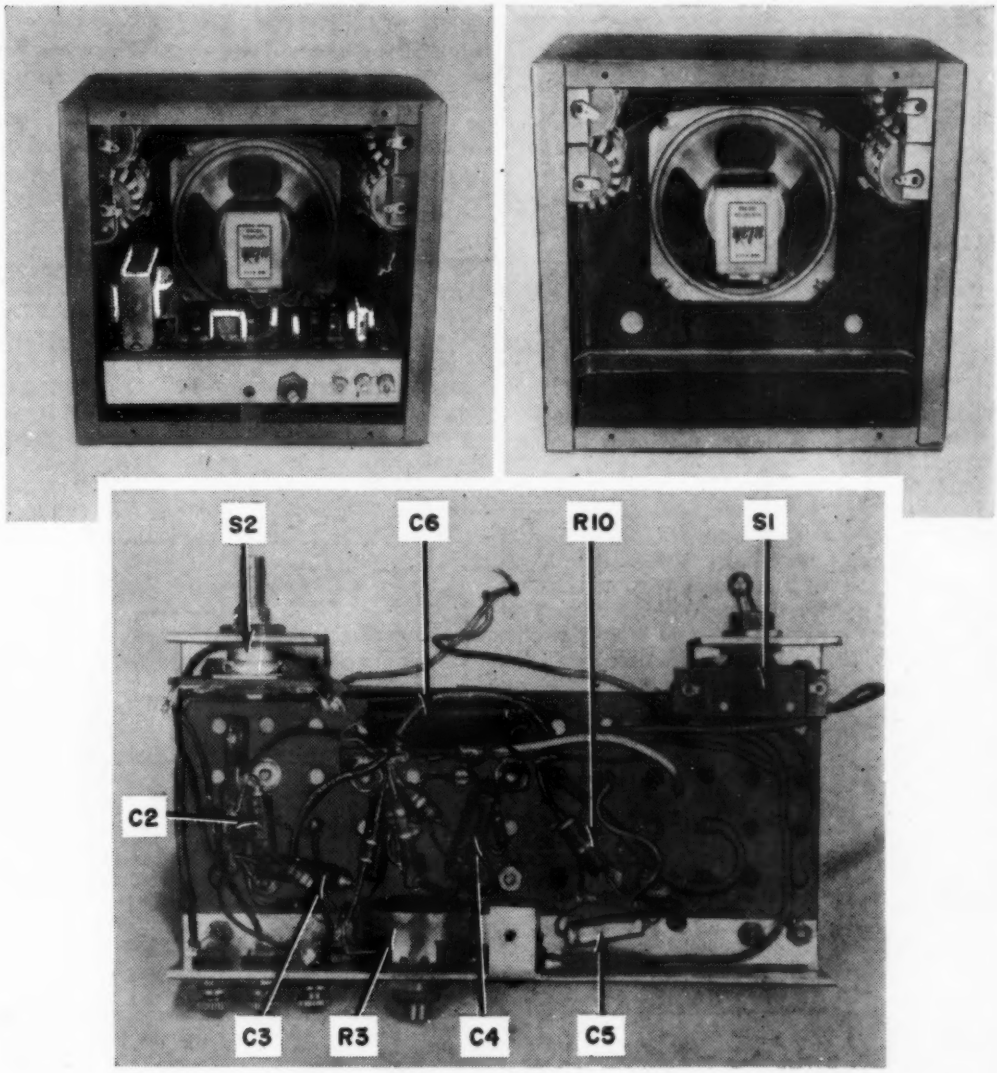
The chassis can be constructed of a scrap piece of perforated Masonite, ¼" plywood (with holes drilled for parts mounting) or even sections of an old cigar box. It's a good idea to apply a couple of coats of acrylic spray to the "chassis" *before* mounting the components. This will prevent moisture from wilting it after installation in the cabinet.

As can be seen from the photos, the power transistor is mounted with *6-32* nuts and bolts, as are *T1*, *T2*, and *T3*. Place a soldering lug under one of the 2N255 mounting nuts and use it for the collector connections. (The 2N255 has the collector internally connected to its shell and so the shell *cannot* be grounded.) Insert tie points wherever convenient and run the common leads to them. The rear bracket and the brackets mounting the switch and control can be cut from an aluminum angle or shaped from sections of a "tin" can.

Layout and wiring are not especially critical as long as care is taken to keep input and output circuits well separated,



B1—6-volt battery (see text)
C1, C3—2-µfd., 6-volt electrolytic capacitor
C2, C4—10-µfd., 6-volt electrolytic capacitor
C5—30-µfd., 6-volt electrolytic capacitor
C6—100-µfd., 6-volt electrolytic capacitor
R1, R9—100-ohm, ½-watt carbon resistor
R2—330,000-ohm, ½-watt carbon resistor
R3—3000-ohm potentiometer (Gain Control)
R4, R7—4700-ohm, ½-watt carbon resistor
R5—270,000-ohm, ½-watt carbon resistor
R6—47-ohm, ½-watt carbon resistor
R8—100,000-ohm, ½-watt carbon resistor
R10—4700-ohm, 1-watt carbon resistor (see text)
S1—S.p.s.t. toggle switch (Power)
S2—D.p.d.t. spring return rotary switch (Centralab No. 1464)
S3—S.p.d.t. normally open push-button switch (Mallory 2003-L)—in Remote



Intercom cabinet with and without amplifier installed (top). The location of major amplifier components can be determined from the view directly above.

preferably at opposite ends of the chassis. If your intercom shows a tendency to whistle, squeal or howl, the problem is probably due to audio coupling through the power supply or to bad parts layout.

The base resistor (*R10*) of the output stage is of a higher than normal value in order to minimize battery drain. If the circuit shows a tendency to distort or overload on strong signals, the value of *R10* can be reduced. With the original 4700-ohm value, the battery drain will be approximately 50 ma. Lowering the value of *R10* will *increase* the amount of current drawn.

As far as the input and output connectors are concerned, any convenient three-terminal strip will do. Binding head connectors were used in the model, but other types may be more easily available.

The 6-volt battery can be made up of four 1½-volt "D" flashlight cells mounted in series-wired battery clips (see above). If

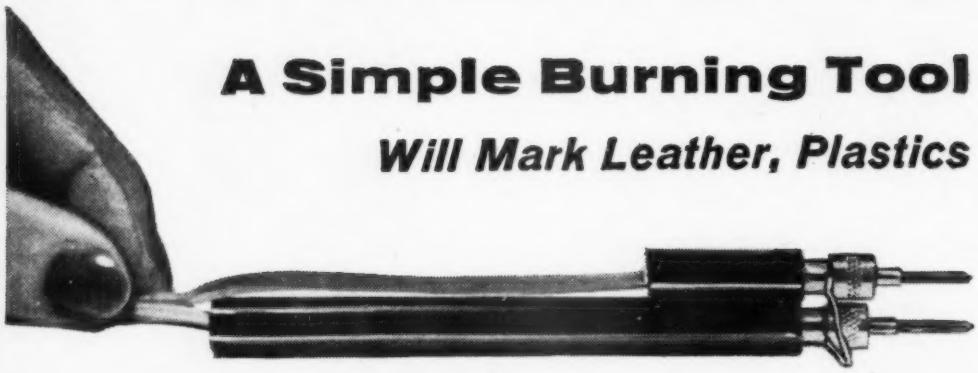
(*Continued on page* 122)

Schematic and parts layout (left) present no difficulties to the experienced builder.

T1—Input transformer; 3-ohm primary, 4000-ohm secondary (Argonne No. AR-125)
T2—Driver transformer; 500-ohm primary, 8-ohm secondary (Argonne No. AR-164)
T3—Output transformer; 48-ohm primary, 3.2-ohm secondary (Argonne No. AR-503)
TR1, TR2, TR3—CK722 transistor (Raytheon)
TR4—2N255 transistor (CBS Hytron)
SPKR.—4" PM speaker, 3-4 ohm voice coil

A Simple Burning Tool

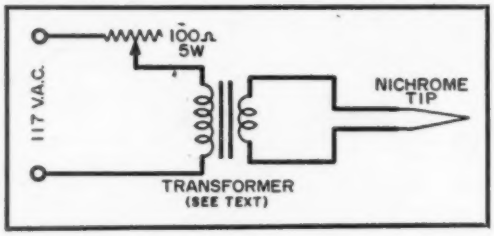
Will Mark Leather, Plastics



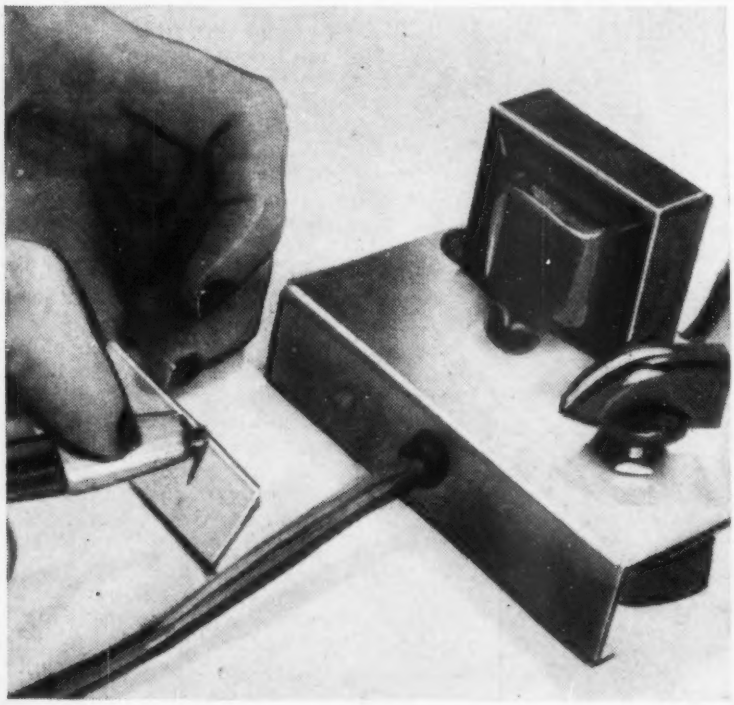
HERE'S a burning tool you can make in half an hour. You can probably find all the materials in your junk box, or at most, they would cost you $3 to $4 at any parts store. The transformer is a 6.3-volt filament transformer capable of delivering 3 or more amps. The 100-ohm, 5-watt rheostat is the temperature control. A short length of Nichrome wire makes up the burning tip, which you can attach to the ends of an ordinary pair of test prods.

You can find a million uses for the tool, particularly with leather and plastic. You can mark your possessions, such as suitcases or leather bags. Or you can burn designs into plastic objects which can then be filled with India ink to make them stand out.

The workings of the power supply can be fitted into a small aluminum chassis. It would be best to use a rubber grommet to protect your power cord, although you could put tape around the edge of the hole you drill in the chassis. The test prods should be glued together by Duco cement or the like. —*Forrest H. Frantz, Sr.*



Schematic above shows how easy it is to build the burning tool. In the photo at top of page, you will note how the Nichrome tip is attached to the ends of the test prods. If you wish, you can remove the prod points, since they may tend to obstruct your work. Cement holds the prods in place.



Note the construction of the power supply in the aluminum chassis. A rubber grommet is used to protect the power cord. Tool is being used to burn name into piece of plastic. The test leads themselves should not be plastic—the heat might melt them.

"Wrap It Up"

with off-the-air recording

By ROBERT SAMPSON

Catch and keep your own collection of music, plays and special news

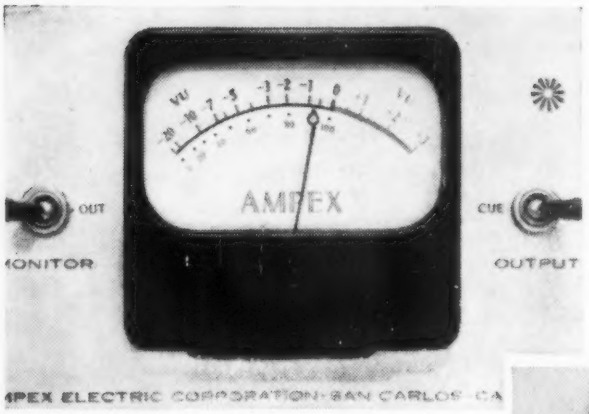
OUT OF your radio loudspeaker old Sidney Bechet comes riding his reed like a wild man on a rocket, soaring on high notes to the ceiling, dropping to the floor with a growl. What a ride the old man does give! Lots of times before, you have listened to Sidney via your radio, and every time has been fresh and exciting.

But this time something very special has been added. When the program is over, you go to your radio, take a few minutes with preparations, then sit down. In a few seconds, here comes Sidney again out of your speaker, with that very same rush to the top of the clarinet range to start things off! You listen through the same driving set of tunes a second time. No doubt about it, you caught the old man on one of his best days. And you caught him for good! You "wrapped it up"—as they say in the lingo of recording engineers.

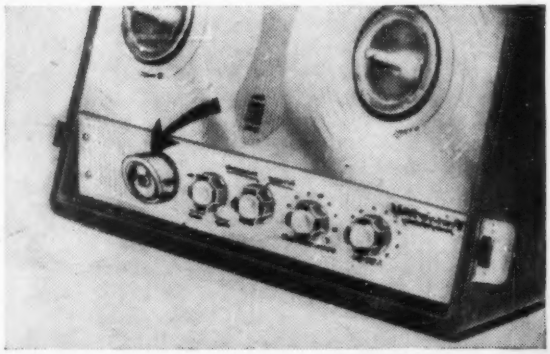
You've got him on magnetic tape, of course. The use of tape to put radio programs away in the locker, for re-use any time the owner feels like it, is one of the fastest-growing indoor hobbies. Symphony concerts, jive sessions, song recitals, historic speeches, any unique radio happening, can be added to your own personal collection of recordings for future enjoyment as long as you like. And you will get a kick out of editing and putting together special programs of items picked out by yourself for your family and friends.

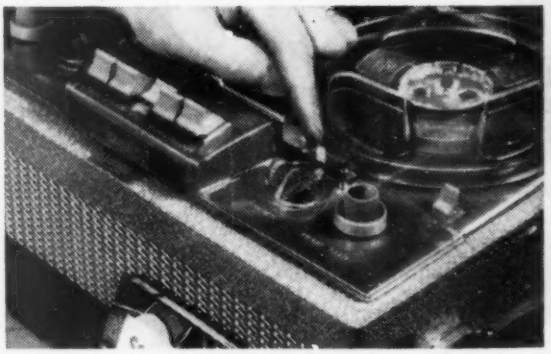
Keep Out of Jail. Before describing the simple procedures for making good off-the-air recordings on magnetic tape, we must first issue a warning. Toss overboard right here and now any brainburst you may have had about selling copies of your off-the-air recordings. The right to make money out of the production of any professional entertainer or out of most other kinds of material you hear on the radio is carefully protected, as it should be.

So invite your friends in to hear your



Volume indicators of three different kinds are used on tape recorders. At left is the professional-type VU meter which monitors the level of every sound entering the machine. The "electronic eye" in the tape recorder below serves the same purpose. The machine in the bottom picture has a neon bulb, which flashes overload warnings but cannot indicate intermediate values of signal level.





own recording of Satchmo or Menuhin, in your living room—yes. But don't try to sell the recording or charge admission to hear it, or you will have legal beagles baying at your heels. This applies not only to original performances on radio, but to any broadcasts of commercial recordings. Taping material off the air is strictly for fun —and fun only.

Simple Setup. Now—what equipment should you have to put the radio programs you want on tape? Basically, all you need is a radio receiver and a tape recorder. Good recordings can be made with just these two instruments. But if you have a separate radio tuner feeding into a hi-fi amplifier with a flexible control system, you can do the job with greater ease in starting, stopping, checking, etc. We will describe both methods of recording.

Suppose you have a standard-model radio receiver, any make, and a portable tape recorder. The first rule is: the signal should be transferred from radio receiver to tape recorder in electrical form—*not* acoustically by putting the microphone in front of the loudspeaker. If you use the speaker-microphone method, you pick up the distortion inherent in these two units and also add room echoes and noises to your recording.

The easiest way to get a signal from the radio receiver to the tape machine is by putting alligator clips on one end of a length of lamp cord and a plug that fits your tape machine input on the other end. Clip the alligator "jaws" to the voice-coil terminals of your radio speaker and plug the other end into your tape machine, as is shown in the drawing at the top of the next page.

This apparently haphazard procedure has some neat advantages. Because the voice coil has a very low impedance, usually less than 20 ohms, the cable will be insensitive to hum and usually won't need shielding. For the same reason, there will be no loss of high frequencies in the cable.

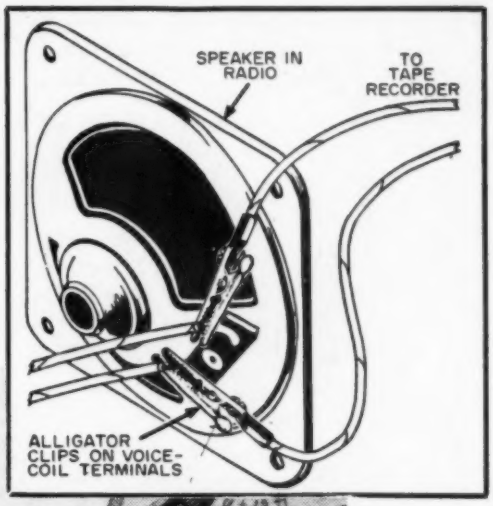
But the tape machine input is high impedance, 100,000 ohms or more. Hence, you will draw practically no power from your radio, and can listen to it in the ordinary way while recording.

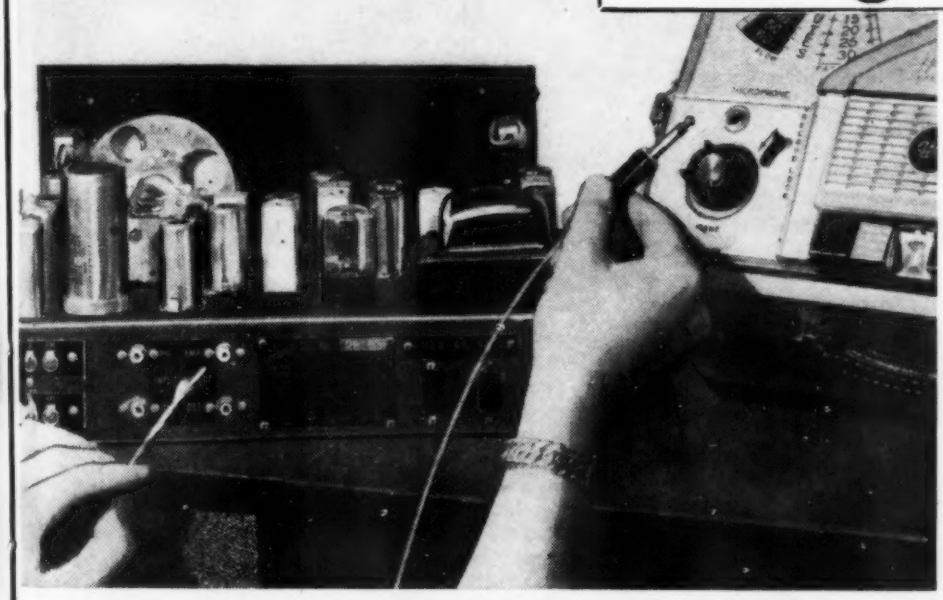
Volume Level. The one adjustment that makes the biggest swing between a dandy recording and a miserable one is getting the right strength of signal into the recording head. Too much signal on the tape, and you overload the tape. Harsh, fuzzy sound will screech at you as the intermodulation distortion rises rapidly. Too little signal, and the softer passages will drown in the background noise which is always present in any electronic sound reproduction system. The volume indicator on your recorder lets you steer clear of the twin pitfalls of distortion and noise.

The loudness difference between the top signal level that is within allowable distortion limits and the noise level is what is known as the "signal-to-noise" ratio. On tape, 3% intermodulation is usually taken as the maximum allowable distortion. Obviously, you will have the most "spread" for the music to rise and fall in loudness if the peaks just reach the "top" on your volume level indicator.

Every good tape machine has a volume indicator that tells you when you have set the incoming signal so that the peaks just hit the top. On the peaks, a neon bulb flashes, or an electronic eye *just* closes, or a VU meter—the most convenient and accurate of all to use—just swings up to "zero," but not beyond. Probably the most important thing you can learn about your tape machine is how to read this signal-level indicator. The photos on page 68 show various popular types of indicators.

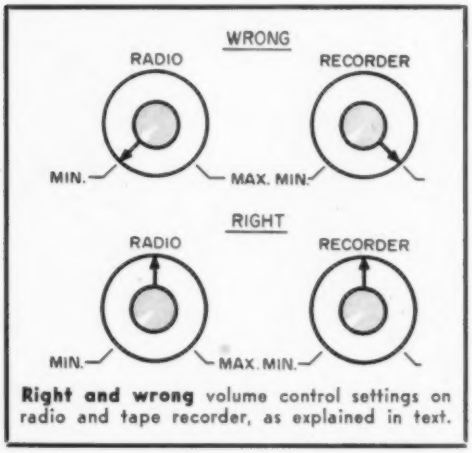
To get the signal level set right, turn on your equipment about 15 minutes before the program you want is scheduled to go on the air. That will allow sufficient warm-up to assure constant gain by the time your program comes on. Tune in the station the program will come from, and set the volume according to the *preceding* program. If this is music, you won't be far off when *your* music comes along. If it is speech, you will probably have to change the level a little when music comes along. But you are bound to be within shooting range of the "right" volume setting, and will need only a small final adjustment.





For simple take-off for recording from any radio, just clip the tape recorder's input lead to the voice-coil terminals of the radio loudspeaker, as shown in the drawing at the top of this page. (In case an a.c./d.c. receiver is used, an isolation transformer should be connected between your radio and the recorder to prevent the possibility of a "hot" recorder chassis and the chance of shock.) However, better tone quality can be obtained by connecting the tape machine input to the output of a hi-fi tuner, as shown in the photograph above.

Dual Control. With a radio receiver feeding a tape machine as described, you have two volume controls located in the signal path. You can get the same level at the tape with different combinations of the two controls, by turning one



Right and wrong volume control settings on radio and tape recorder, as explained in text.

up while you turn the other down. The right combination is with both controls somewhere near the same setting, and *not* with one all the way up and the other almost off.

This "no loafing" method avoids two bad extremes: (1) a signal out of the radio so strong that the first amplifier stage in the tape machine is overloaded, causing distortion (which would be the case with the radio control way up and tape recorder control way down); and (2) a signal out of the radio so low that the soft passages are down near the noise level (radio control way down and the recorder control nearly all the way up).

"Dry Run." You can save a lot of agony by making a short "dry" test-run during the warm-up period. Suppose you wait until Satchmo starts to blow his horn to get your tape machine moving for the first time. *Then* you find out that you have a gremlin in your take-up reel, or a shorted recording head, or some other crippling defect. Then it's too late, old boy; Satchmo has escaped for good with that particular dish of jive.

Record a few minutes of the preceding program, and listen to it carefully. Harsh, distorted quality means too high a signal level unless there is something wrong with your amplifier. A muffled quality, with highs heavily attenuated, probably means a tiny piece of dirt on the recording head. Clean the head carefully. (See POPULAR ELECTRONICS, May, 1957, page 87.) You will be able to correct many troubles if you discover them about 15 minutes *before* you "go on stage."

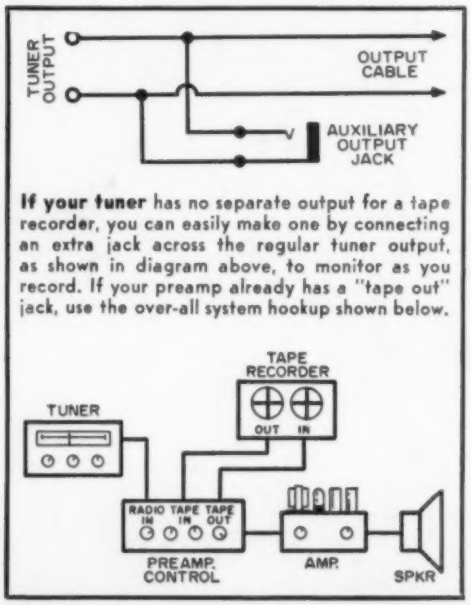
After actual recording starts, don't keep changing the volume setting; leave it strictly alone unless it turns out to be radically wrong. A recording on which the volume level is frequently changed sounds "broken up" and loses much of its impact in the volume waver caused by your knob twisting. It is the mark of a good recordist to set the level carefully, but then leave it set.

Catch It All. Begin to record about 20 seconds before your program goes on, and *don't* start and stop the recorder to edit out short stretches you think you don't want. Let it run through everything. It's much better to edit out what you don't want *after* the recording is made. The tape can always be re-used—and you get a proper chance to decide for sure—at your leisure—what you want to keep. If you missed something in the original recording that turns out to be necessary for good continuity, it's lost for good.

These instructions hold true for any kind of setup used in off-the-air recording. So far, we have assumed that you get your signal from the loudspeaker terminals of your radio by means of alligator clips. However, you can feed your recorder a somewhat cleaner signal if you tap it off somewhere ahead of the output stage of the receiver. Most of whatever distortion there may be is created in the output stage. Several methods for taking a signal out of a previous stage of a radio receiver were described in the March, 1956, issue of POPULAR ELECTRONICS, page 74.

Fancy Hook-ups. The best way to get a top-quality signal off the air and into your tape machine is to employ a separate radio tuner, such as is used in high-fidelity systems. The best quality is, of course, obtainable only from FM.

(*Continued on page* 140)

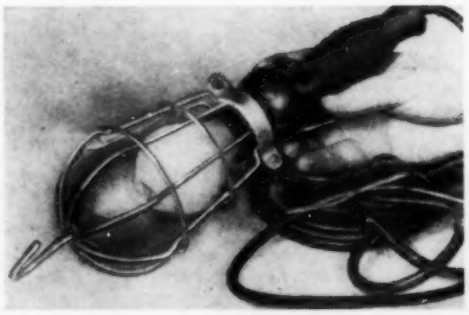


If your tuner has no separate output for a tape recorder, you can easily make one by connecting an extra jack across the regular tuner output, as shown in diagram above, to monitor as you record. If your preamp already has a "tape out" jack, use the over-all system hookup shown below.

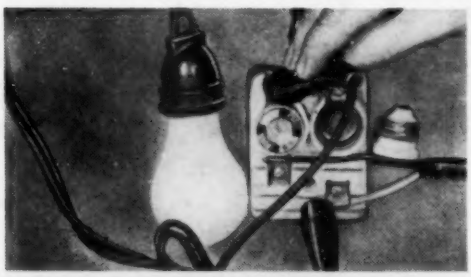
Test lamps come in a variety of sizes and shapes. Included in the photo below are manufactured neon lamps, drop lights, and homemade test lamps and sockets. Any of these can be used to check fuses and mysterious a.c. grounds.

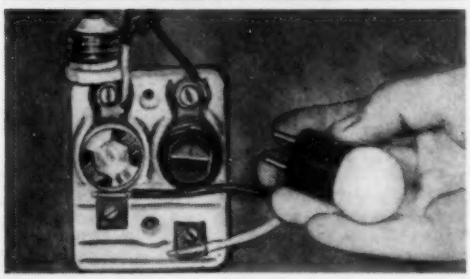
Using a Test Lamp

By H. LEEPER

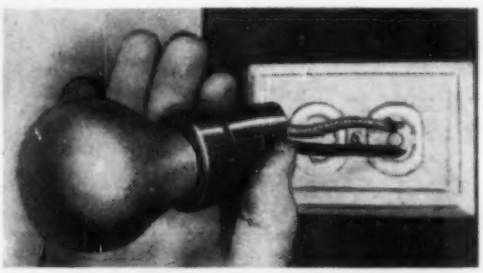


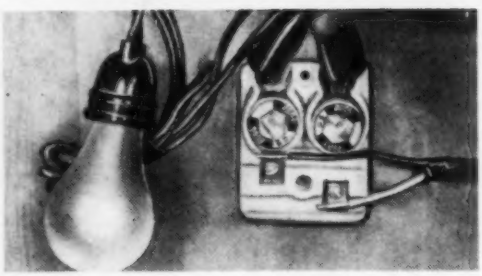
You can buy a general-purpose "test lamp" in most electrical appliance stores for a few cents. It consists of a socket and short lengths of heavy wire leads which are bared. Using a low-wattage bulb, check a.c. availability by sticking the leads into an a.c. outlet (above, right). The author extended his socket leads with sealed-in lengths of wire (below, right). The rubber-covered alligator clips shown provide a safe method of contacting hot a.c. lines. A two-fuse line is being checked out here.





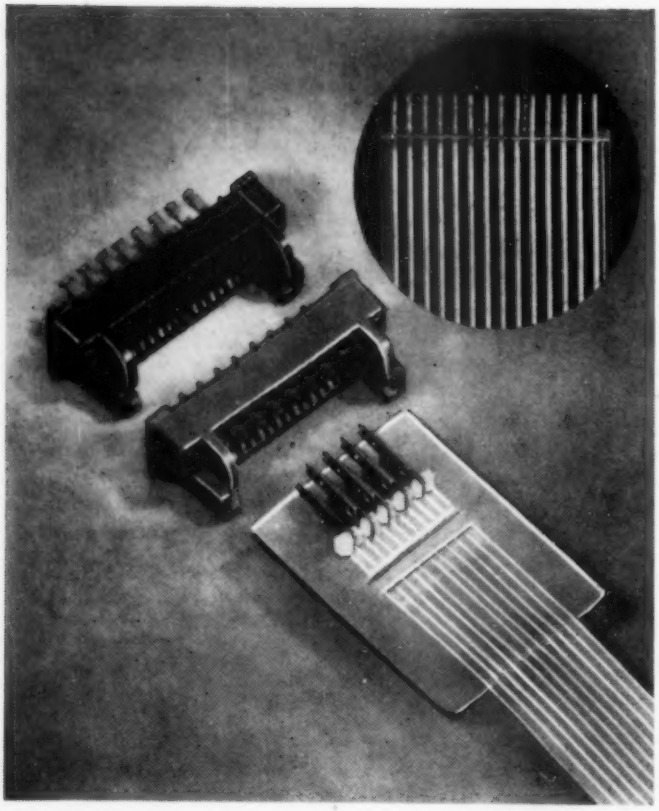
Drop lights with extension cords should be well insulated with a shade and heavy wire screen protecting the bulb (left). Some of these drop lamps will have a built-in switch, a handy item if the light is to be used regularly.





Occasionally it is difficult to see whether a fuse has blown. To "cross-check" fuses, remove one and tap the test lamp from the input to appliance side of fuse (above, left). If the light glows, the fuse removed is burnt out.

A low-amperage ground often eats up current without notice. To check for such a ground, turn off all electrical gadgets in the house, and insert the connector plus bulb (left). If bulb glows, the ground indicated should be located quickly to prevent a fire hazard.

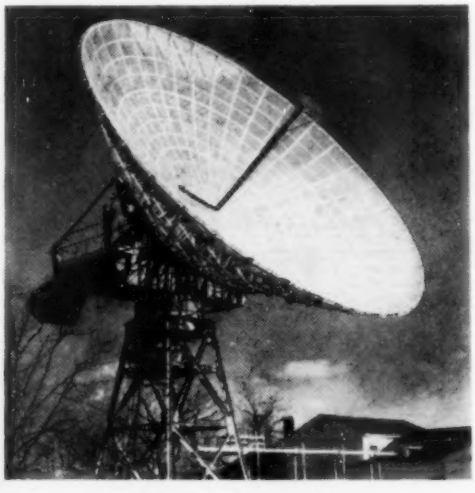


Tape Cable

A minor revolution in electronics design seems in the making with the introduction of "Tape Cable," a new concept in current carriers. Developed by Tape Cable Corp., Rochester, N. Y., it is a ribbon-like, flexible film in which are imbedded flat, copper conductors lying side by side. It comes packaged in rolls of varying widths, and can be dispensed like tape. The flat construction allows simultaneous stripping of all conductors (inset, left). Major labor savings are seen since all conductors can be dip-soldered simultaneously to a printed chassis or plug (left, with Elco connectors). The polyester insulation is resistant to many chemicals and to boiling and freezing. Flex strength is unusually high. The price is about the same as that of ordinary cable but is expected to go down.

Getting the Picture

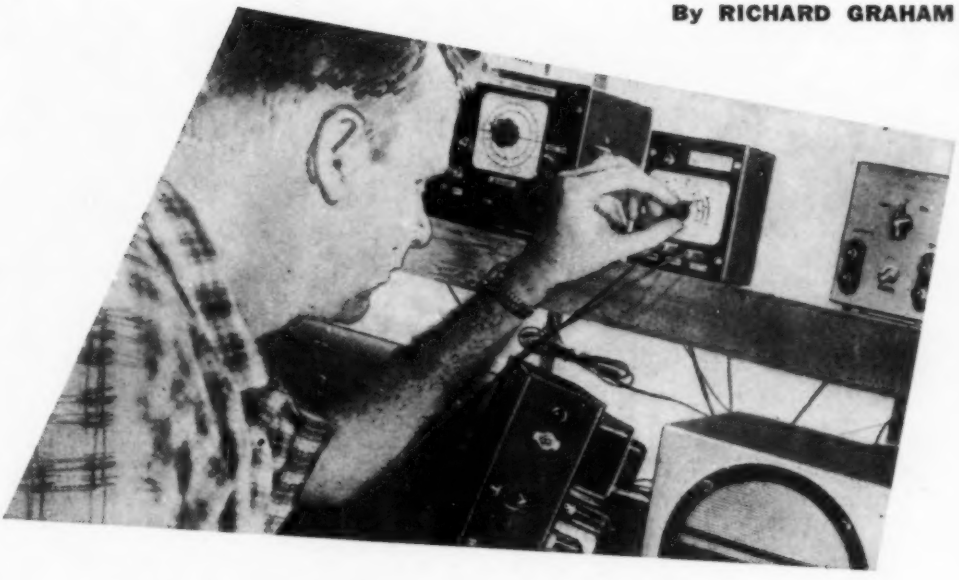
"Sylvatron," a system of producing images on flat panels, is a development of Sylvania. It combines the principles of electroluminescence and photoconductance in glass panels with control layers excited by electrical or optical signals and a power source. Able to reproduce moving pictures (below), and having the ability to store "tracks" and moving pips, the system is expected to prove useful in air and harbor traffic control.



"Moon" Radar

The Signal Corps' *Diana* moon radar antenna is being used to bounce signals off the moon in order to calibrate equipment in the Minitrack stations which are being prepared to track the earth satellite. Echoes are picked up at a Maryland station.

By RICHARD GRAHAM



Make Your Own "Economy" Multitester

It's a low-cost means of measuring voltage and resistance —ideal for beginners

USUALLY the first piece of test equipment to be acquired by the electronic experimenter is a multitester or VOM. Once in a while, though, this acquisition is delayed while the necessary capital accumulates. The multitester described here isn't intended to replace any of the VOM's or VTVM's available in finished or kit form, but it will enable you to have the fun of electronic experimenting while you're waiting for the "real thing." Best of all, it's guaranteed not to deflate any but the most meager of pocketbooks.

The neon tester will measure a.c. voltages between 40 and 200 volts, d.c. voltages between 60 and 300 volts, and resistances between 10,000 and 250,000 ohms—all those most generally encountered.

Construction. Only a minimum amount of time is necessary to construct the tester. As a matter of fact, to duplicate the unit described requires only the drilling of seven holes. I housed my tester in a 3" x 4" x 5" metal utility box. As there are no critical components or wiring in the unit, successful operation is practically guaranteed after construction and calibration.

Power transformer *T1* is wired to the panel but mounted inside the box. Since the transformer leads aren't quite long enough for you to mount the transformer and then wire it, first wire the unit, including the transformer, and then mount the

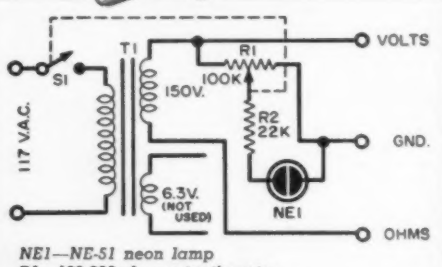
HOW IT WORKS

This tester utilizes the firing voltage of a NE-51 neon lamp to measure both voltage and resistance. When the tester is used to measure voltage, the unknown voltage is applied across calibrated potentiometer *R1*. This resistance is adjusted to divide the unknown voltage and apply some of it to the neon lamp (*NE1*). For the NE-51 model, this is approximately 60 volts. Thus, the setting of *R1* at which the neon just fires will then denote the value of the voltage being measured.

When the tester is used to measure resistance, the transformer secondary voltage is effectively placed in series with the external unknown resistance and calibrated potentiometer *R1*. Now the voltage is divided between the unknown resistor and *R1*. Voltage across *R1* is actually a measure of the unknown external resistor. The higher the external resistance, the less voltage drop appears across *R1*. Conversely, the lower the external resistance, the higher will be the voltage drop across *R1*. This voltage drop is measured by the same action just described for the voltmeter. However, in this case, the voltage being measured is calibrated in terms of resistance.

Resistor *R2* is used as a current limiting resistance.

Always have the common probe connected. A severe shock can result if you contact both the "ohms" and "volts" jacks simultaneously.



NE1—NE-51 neon lamp
R1—100,000-ohm potentiometer
R2—22,000-ohm, ½-watt resistor
S1—S.p.s.t. switch (on R1)
T1—Power transformer, primary 117 volts; secondary 150 volts, 25 ma. (Stancor P8181 or equivalent)
1—3"x 4" x 5" utility box

Schematic diagram of the unit, with parts list.

transformer inside the bottom of the box. The neon bulb (*NE1*) is mounted by forcing it into a rubber grommet on the panel of the instrument. Be sure to mount the grommet on the panel first, then gently slide the bulb into it. Also, don't forget to use insulated tip-jacks through the metal panel of the instrument. If you make your own box out of Masonite or plywood, however, this won't be necessary.

The filament winding on the power transformer is not used. Taping up these leads is a better practice than simply cutting them off, for you may eventually want to use the transformer for another purpose.

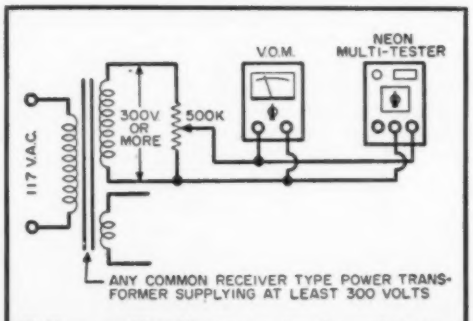
Calibration. The voltage calibration of the neon tester is best accomplished by direct comparison with another multimeter. Meters of this type are about in such great profusion that you should have little difficulty in borrowing one temporarily. If a friend with a VOM is not immediately available, you might try the local radio/TV service shop. Most of these people are pretty friendly and helpful about things like this. The calibration can be done "on the spot" in just a few minutes if the procedure and necessary test setup are prepared beforehand.

Before beginning the actual calibration, prepare a finished blank scale. It should consist of three concentric circular scales without calibration marks. For best results and greater durability, use India ink in preparing the scale and later in making the calibration marks and figures. The scale can be made on a white file card.

Put the blank scale in place on the front panel of the tester. Since you'll want to remove it later on for the finishing touches, fasten it in place with two small tabs of Scotch tape.

Voltage calibration can be effected with the setup shown in the diagram below. The transformer, which can be any common receiver-type power transformer, supplies the voltage necessary to calibrate the upper end of the scale. With the 500K pot adjusted so the "standard meter" reads 40 volts, adjust the neon tester control (*R1*) until the neon just ignites and begins to glow. The voltage at this point (as read on the "standard meter") should be marked on the blank scale in pencil. The pencil mark will be inked over later.

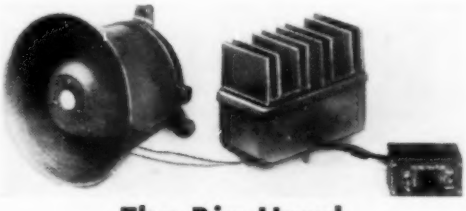
(*Continued on page* 138)



Voltage calibrating setup for the multitester.

Electronics Comes to the Aid of Psychology

Man doesn't necessarily see what he thinks he sees. That is a psychological fact. In order to keep strict control over subjects in group testing, a Rutgers University professor uses Du Mont oscilloscopes as an aid to determining what they think they see. He flashes a disc on the blackboard, then covers it. The students then expand or contract the electronic circle on the 'scope by turning the knob according to the size they remember. After that, it's simple to check their "memory" against the actual size of the circle by the images on the faces of the oscilloscope tubes. In this way, the subjects can concentrate on getting the right size, rather than on drawing a perfect circle—which might detract them from their job.

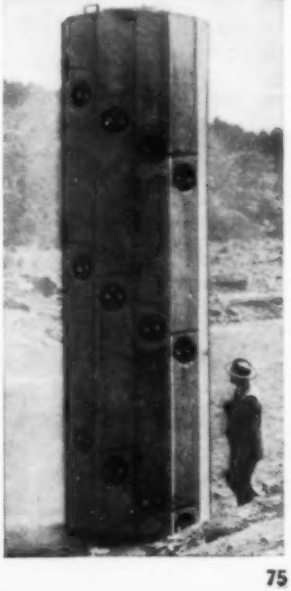


The Big Howl

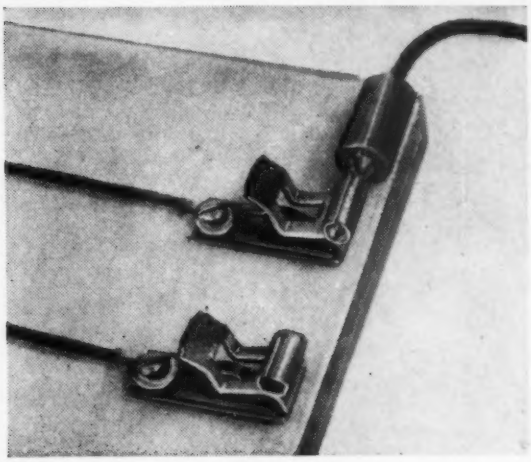
Biggest noise of the month is the "Penetrator," claimed to be the first transistorized siren and public address system. While it sounds like an ordinary siren, that's as far as it goes. A simple flip of the switch gives you a powerful amplifier system with adjustable control. Another position will amplify the radio so that it can be heard a mile away. The system is for use on motorcycles as well as autos. Manufactured by Electronic Engineering Enterprises, Scottsdale, Arizona, it has a frequency selected to give maximum penetration into another vehicle, unlike the ordinary siren which achieves maximum power at its highest frequency. Penetration however, is said not to be the best at this highest frequency.

Flood Fighter

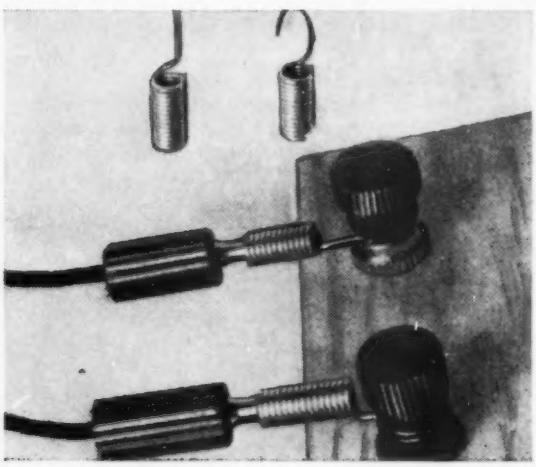
On Christmas Eve, 1953, a railroad bridge was washed out by a raging river flood, killing 151 people. So that such a disaster would never happen again, this 20-foot pylon was imbedded in the river. It has a series of electrodes at regular intervals on the downstream side. As the water rises, they flash warning lights at the next station. The system is battery-operated and is proof against weather, boulders, ice, mud.



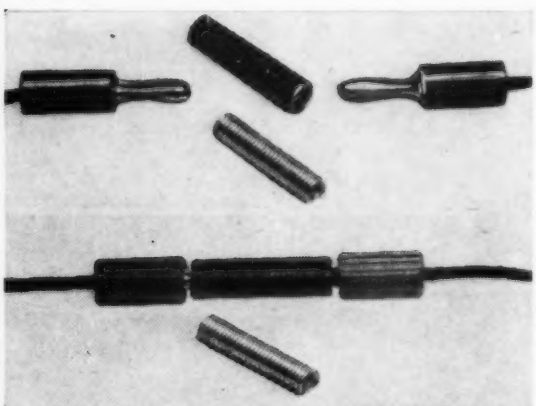
More Tricks with Banana Plugs and Adapters*



IT'S A TOUGH JOB to fit standard banana plugs onto Fahnestock clips without bending either the clips or the split noses on the plugs. Try soldering short lengths of metal tubing onto some of your clips, as shown at left, to enable firm connections to be made between the clips and plugs. Obtain some steel, brass, or copper tubing having the correct inside diameter, and cut it up into ⅜" or ½" lengths; then solder the sleeves onto the Fahnestock clips. If you have trouble locating metal tubing of the right inside diameter, you can bend your own sleeves using tin salvaged from a tin can. Another trick is to cut a lengthwise slot in the metal sleeve so that you can spread or pinch it to the correct inside diameter to fit the banana plug snugly.



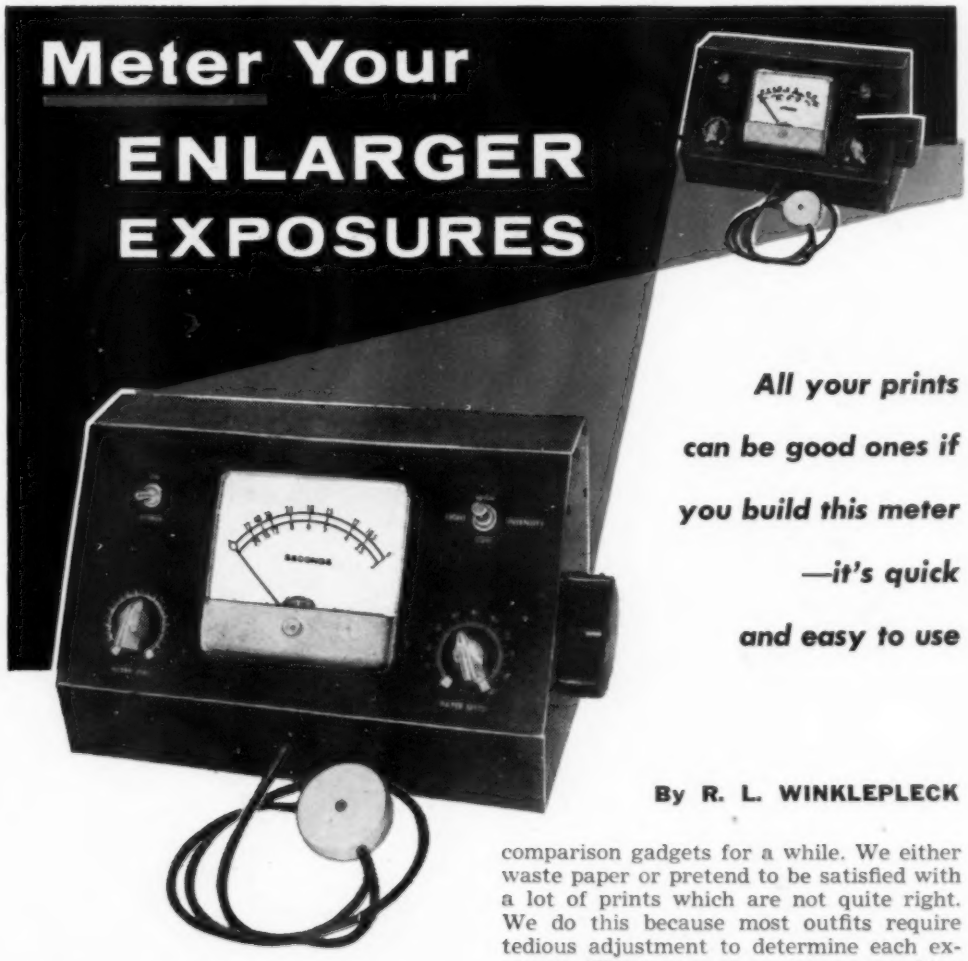
When you want to connect standard banana plugs to apparatus using various types of binding posts, the simple adapters at left center will help you out. Obtain a No. 42-S spring sash rod (10 cents at all dime stores), and clip off a few ⅝" lengths with a pair of sidecutters. Uncoil one end of each piece of spring and straighten it out. Bend a ½"-long hook on some of the springs, and leave a ½"-long straight pin on the others, as shown. The binding post nearest top of photo is of the standard variety, such as is found on "hot-shot" batteries, etc., and it uses the hook type of adapter. The one at the bottom is the "Eby" type having a hole to receive a wire lead, and it uses the straight-end adapter.



With simple, insulated, dual receptacles (below, left), you can quickly and economically extend test leads which use standard banana plugs on the ends. Cut off a few 1"-long pieces of the spring sash rod with your sidecutters, and smooth the sharp edges of the cut wire with a file. To insulate your couplers, and to color-code them, half may be covered with black Mystik tape (see top coupler), and the others with red tape. The inside diameter of the No. 42-S rod is just right to make a snug fit with standard banana plugs, but any other spring stock or metal tubing of the correct inside diameter can be used instead. —*Art Trauffer*

* See "Versatile Banana Plugs Simplify Connections," August, 1957, p. 62.

Meter Your ENLARGER EXPOSURES



All your prints can be good ones if you build this meter —it's quick and easy to use

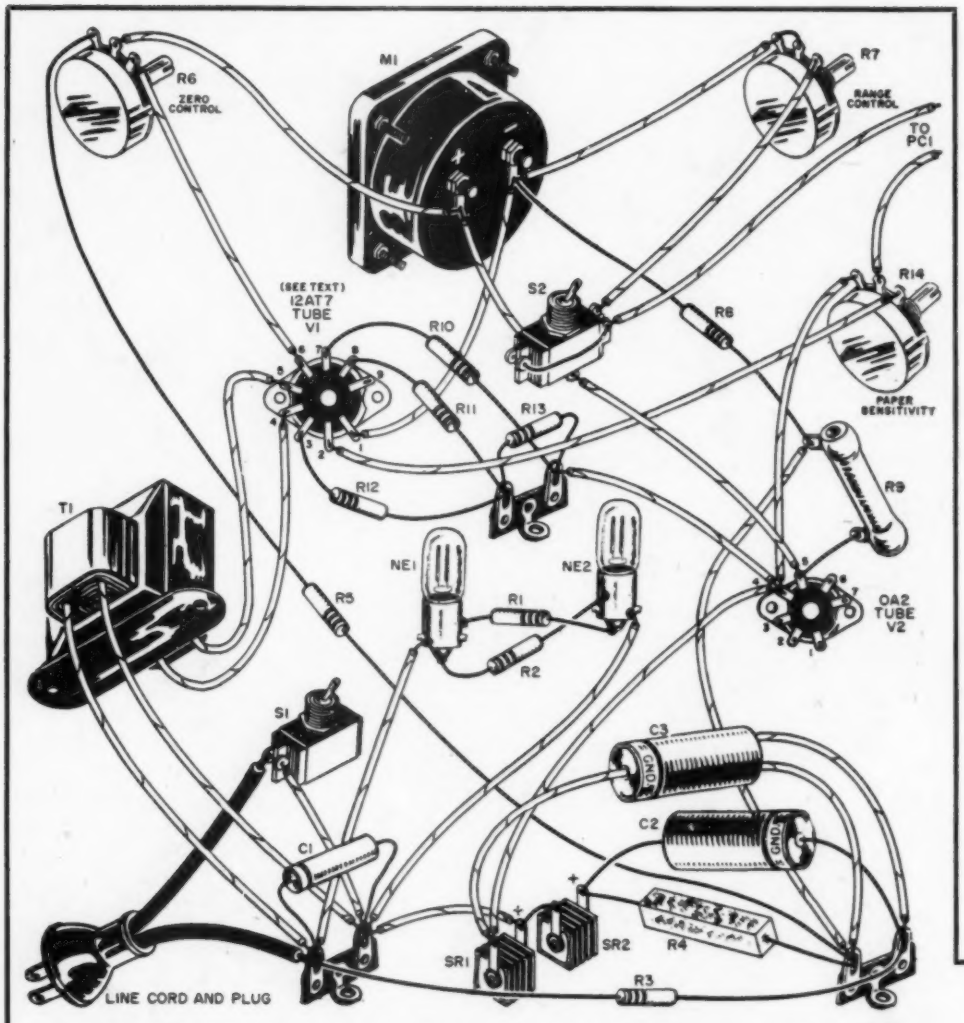
By R. L. WINKLEPLECK

ONE OF THE FEW operations in the field of photography which has not yet bowed down to automation is that of determining the precise exposure under the enlarger that will produce a perfect print. We refer to mechanical or electrical gadgets for the distance from camera to subject and for the correct film exposure. We use an automatic timer for our developing. The enlarger automatically focuses the image on the paper and the proper exposure is made for us by a timing mechanism. But to determine this exposure, we still resort to trial and error.

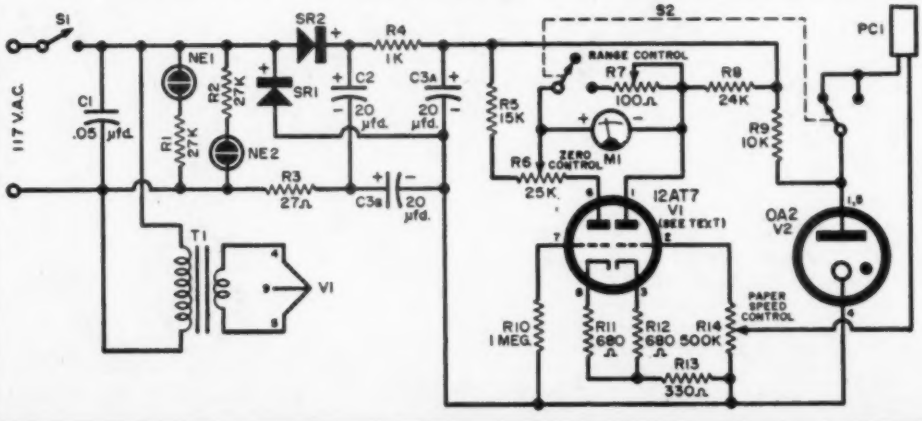
It's true that there are many different pieces of equipment on the market specifically designed to determine the enlarging exposure, but do you and your friends consistently use such equipment? Most of us start off an enlarging session with good intentions. We make a couple of test strips, a practice which is really systematized trial and error, or we use one of the illumination comparison gadgets for a while. We either waste paper or pretend to be satisfied with a lot of prints which are not quite right. We do this because most outfits require tedious adjustment to determine each exposure. What we really want is something as quick and easy to use as the familiar exposure meter.

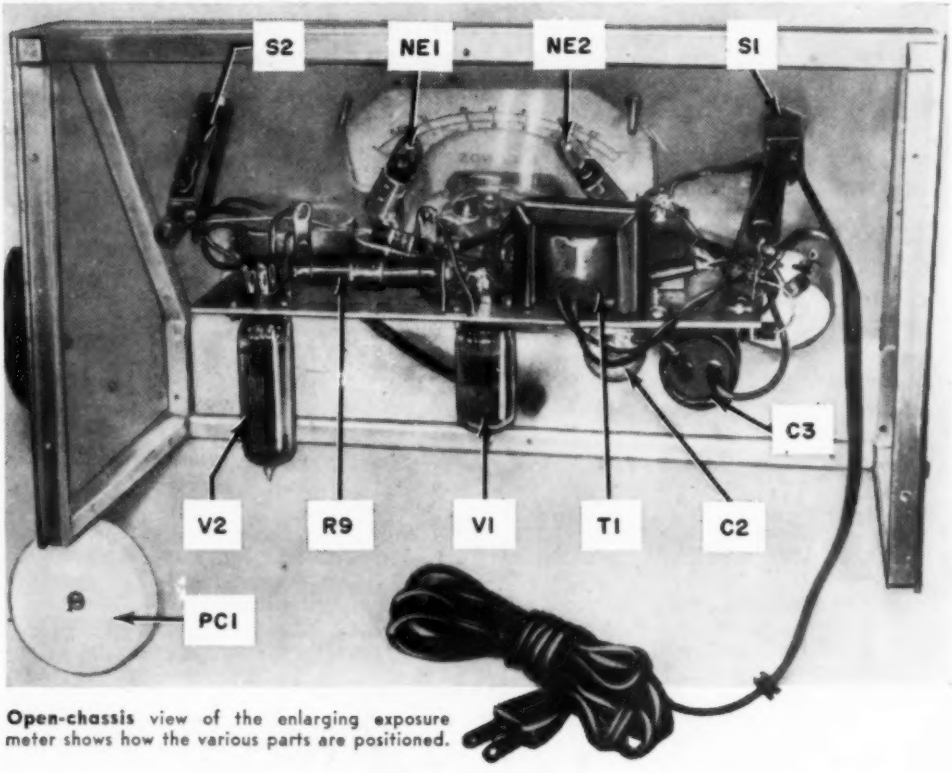
The enlarging exposure meter described here has a small light-sensing element. As soon as the switch is closed, the correct exposure may be read directly in seconds on the meter. Once calibrated for your conditions, less than five seconds is required to determine the right exposure time.

The degree of sensitivity required will vary with the enlarger being used, the degree of enlargement, and the kinds of enlarging paper. So it's difficult to specify the exact tube which should be used. The cathode resistors, therefore, have been selected to permit use of several tubes with different amplification factors. If you customarily use a condenser enlarger, fast paper, and make relatively small enlargements, a 12AU7 will probably perform best. If you want more sensitivity because you use a diffusion enlarger, slow paper, and make big enlargements, you may need the greater



You'll find the pictorial and schematic diagrams helpful in putting the meter together. While V1 is shown here as a 12AT7 tube, your particular needs might call for a 12AU7 or a 12AV7, either of which can be used without circuit modification (see text). Parts list is at right.





Open-chassis view of the enlarging exposure meter shows how the various parts are positioned.

amplification provided by a 12AT7. If neither of these extremes seems to fit your conditions, a 12AV7 might be best. These three tubes can be used interchangeably without circuit modification.

A large meter is desirable for quick and accurate readings and a plastic model can be easily illuminated for darkroom use. In the unit illustrated, the meter opening in the sloping panel cabinet is enlarged; so two neon lamps, mounted behind the meter, adequately illuminate the translucent meter scale. Neon lamps have the advantage of being non-actinic and will not fog enlarging paper.

The size of the cabinet is not critical and the wiring can be point-to-point, using a minimum of tie lugs. If a sloping-panel cabinet is chosen, the inverted chassis arrangement shown makes a compact arrangement possible with very short leads. To eliminate any possibility of shock, the cabinet and chassis are isolated from the circuit.

The light-sensing element is one of the relatively new cadmium sulphide photocells which has a very high dark resistance, decreasing rapidly as light intensity decreases. Such cells are very small, measuring ¼" in diameter and ½" long. This is important since we want to measure the intensity of a very small spot of light on the easel of the enlarger. Also, the resistance of the cell varies significantly and proportionately with light intensity at the low levels with which we are concerned.

Photocell *PC1* is mounted in the center

PARTS LIST

C1—0.05-μfd., 400-volt tubular capacitor
C2—20-μfd., 300-volt electrolytic capacitor
C3a/C3b—20-20 μfd., 300-volt dual electrolytic capacitor
M1—0-1 ma., 4½" plastic rectangular meter
NE1, NE2—#51 neon pilot light
PC1—Cadmium sulphide photocell (Clairex CL-2)
R1, R2—27,000-ohm, ½-watt resistor
R3—27-ohm, 1-watt resistor
R4—1000-ohm, 7-watt resistor
R5—15,000-ohm, 1-watt resistor
R6—25,000-ohm, wire-wound linear potentiometer (Zero)
R7—100-ohm, wire-wound linear potentiometer (Range)
R8—24,000-ohm, 1-watt resistor
R9—10,000-ohm, 5-watt resistor
R10—1-megohm, ½-watt resistor
R11, R12—680-ohm, 1-watt resistor
R13—330-ohm, 1-watt resistor
R14—500,000-ohm linear potentiometer (Paper Speed)
S1—S.p.s.t. toggle switch
S2—D.p.d.t. toggle switch, spring return to center off (Cutler-Hammer or Switchcraft)
SR1, SR2—65-ma. selenium rectifier
T1—12.6-volt filament transformer (6.3 volts can be used by connecting one lead to pin 9 and the other to pins 4 and 5)
V1—Duo-triode tube (12AT7, 12AU7 or 12AV7—see text)
V2—OA2 tube

HOW IT WORKS

The heart of the circuit is a duo-triode tube (*V1*) connected in a balanced-bridge circuit similar to that used in a VTVM. This circuit is also called a difference amplifier. A meter (*M1*) is placed across the two anodes of the tube and a potentiometer (*R6*) in the meter circuit permits zeroing the meter. One triode section has fixed bias with resultant steady current flow, while the other section has a variable grid bias due to the action of a light-sensing cell (*PC1*). The difference in plate current flow is very much greater than the difference in the bias voltages on the two grids.

A positive voltage, stabilized by a regulator tube (*V2*), is applied through *PC1* to one of the grids of the duo-triode tube. When the cell is dark, its resistance is so great that it has little effect on the bias voltage; but when light strikes the cell, its resistance decreases, the bias becomes slightly less negative, and increased current flows through only this one section of the tube. This difference between the two sections is read on the meter which is calibrated in seconds to indicate proper exposure.

A filtered selenium-rectifier (*SR1-SR2*) voltage-doubler circuit supplies approximately 250 volts to the plates of *V1*, while *V2* limits the photocell to 150 volts. A potentiometer (*R14*) in the variable grid-bias circuit varies the load on the photocell so that its sensitivity can be varied to match that of different grades of photographic papers. Two exposure ranges are provided to cover a wide range of light intensities; this is necessary since meter response is essentially linear, varying directly with light intensity, which crowds the longer exposures onto the lower end of the meter scale.

of a wood or plastic disc 2" in diameter and slightly over ½" thick, with the leads soldered to a 3' length of insulated microphone cable connecting it to the instrument. The top of this block should be painted white so that the cell may be more easily centered in the correct position when determining an exposure.

Keep in mind that this is not a thinking, reasoning machine. It is subject to the same restrictions in use as the conventional exposure meter. Best results, therefore, will be secured by using the readings as indicators or guideposts and, where necessary, modifying them slightly to fit specific conditions.

With a perfectly exposed and developed negative, you can accept the readings as gospel truth. Suppose, however, you're working with a negative which was overdeveloped. It has clear shadow areas (in which you'll take your reading) but the middle tones and highlights are too dense. Exposing by meter reading will produce a light print. The same thing is true in reverse if you're working with a very thin negative. In both cases some interpretation is necessary. —30—

CALIBRATION PROCEDURE

A trial run will show that the *Zero Control* (*R6*) gives adequate adjustment of the meter and that there is a response when the cell (*PC1*) is exposed to dim light. Now establish the two meter ranges. Remove the OA2 tube (*V2*) to isolate *PC1*. Turn the unit on and let it reach operating temperature. Turn the *Light Intensity* switch (*S2*) to *Low*, and with *R6*, adjust the meter to read some amount near full deflection, 90 for example. Then turn *S2* to *High* and adjust the *Range Control* (*R7*) to one-third of the *Low* reading (30). This will give you two exposure ranges, one being three times the other. Now replace *V2*.

Final calibration must be done in the darkroom. Select a negative of average contrast which will require an exposure as short as you customarily encounter. Run a series of test strips in the enlarger and determine exactly the correct exposure. Let's say you decide on 3 seconds. Warm up the unit and place *PC1* on the enlarger easel with the sensitive surface in a shadow area of the image. The brightest light on the easel (which is the shadow area of the picture) will give the most consistent readings. Throw switch *S2* to *High* and adjust the *Paper Speed Control* (*R14*) to provide full meter deflection. This point on the meter will be marked as 3 seconds on the new meter scale.

If full-scale deflection can be secured without approaching the lower end of *R14*, where the cell load would be too low to provide linear readings, you're all set. If this can't be done, you should substitute a new *V1* tube providing more amplification, or change the two scales to 2:1 instead of 3:1 by readjusting *R7*. If *R14* is extremely sensitive, it would be best to substitute a tube with less amplification.

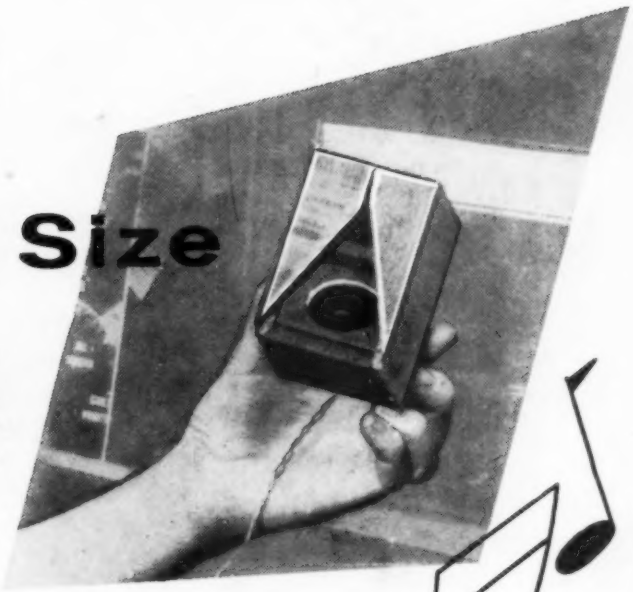
Since the meter reading and the light intensity are directly related, one-half the light intensity giving full deflection should give one-half meter deflection, etc. Thus, if a 3-second exposure deflects the meter fully, a light intensity requiring a 6-second exposure should give half deflection and a 12-second exposure illumination should deflect the meter only to one-quarter of full-scale. Check this out with some additional test exposures. If it checks, the new scale can be made directly from the old one. If there is some variation from this ratio, the exposure times can only be established through the use of test strips and the meter scale made up accordingly.

The new meter scale can be drawn with India ink on a sheet of frosted 1/16" plastic cut to the size of the regular scale, or on tracing paper covered with a sheet of clear plastic. Assuming that a calculated scale based on linear response will be essentially correct, multiply the exposure time established as producing full meter deflection by 100. This figure, when divided by any longer time interval, will give the percentage deflection for this time. Thus, if full deflection is 3 seconds, 3 x 100=300. Four seconds on the scale would be 300÷4=75% deflection; 12 seconds would be 300÷12=25% deflection, etc. These points are easily found since the meter scale generally has either 50 or 100 divisions, and the new translucent scale can be made as a simple tracing. The 2x or 3x range, of course, has the same scale points.

The setting of the *Paper Speed Control* should now be noted. This position of *R14* is the one which will always be employed with the particular paper used during this calibration. You can similarly establish a setting for different grades of paper.

With calibration completed, the correct exposure is as quick and easy to determine as placing the light cell in position on the easel and throwing a switch. As components age and sensitivity decreases, the calibration may require slight adjustment.

Low in Size Hi in Fi

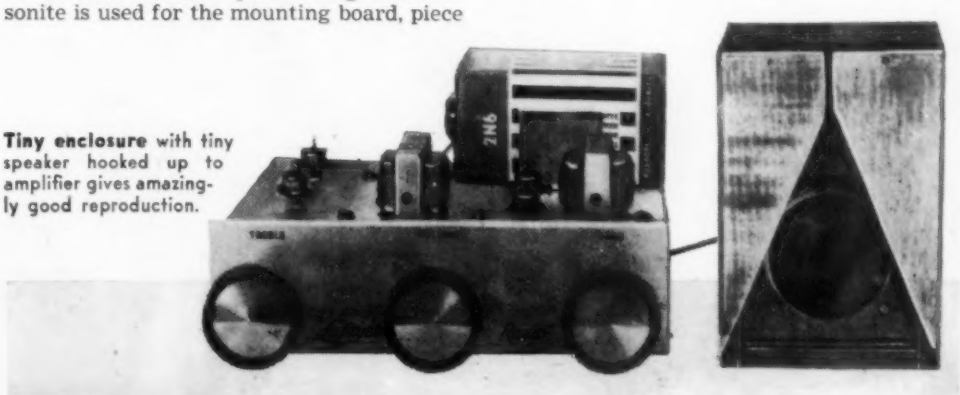


Pocket-size enclosure puts life in tiny speaker

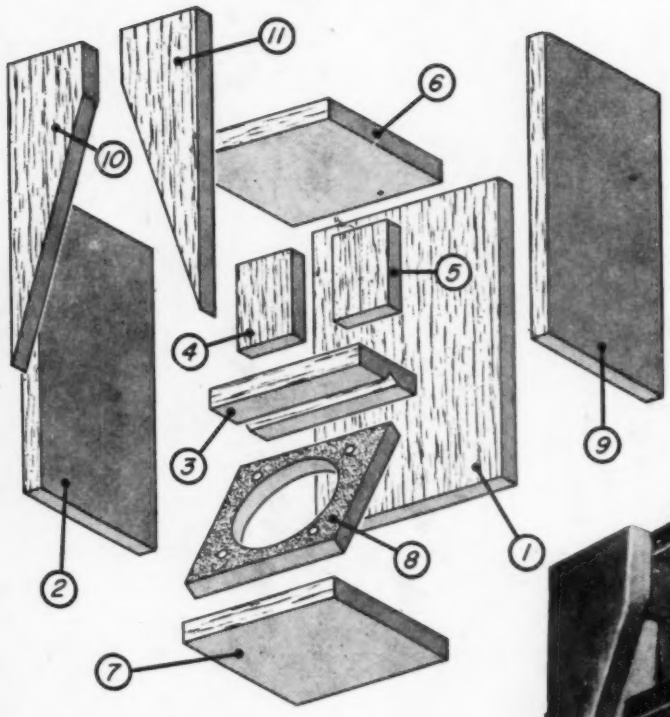
By B. VAN SUTPHIN

YOU CAN PEP UP the weak bass response in a miniature speaker by putting it in a high-fidelity type wooden enclosure. Perhaps the smallest ever made is shown in the photo—it's three inches high. It houses an Argonne AR-95, a 1½" speaker (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.). This Karlson-type speaker baffle has straight-cut wings, rather than an exponential curve, to simplify the job. The gap at the top improves high-frequency response.

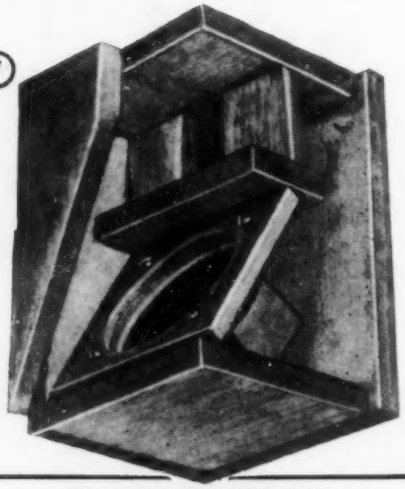
Use quarter-inch wood, cut to the dimensions shown in the exploded diagram. Masonite is used for the mounting board, piece No. 8, so that it will cut perfectly. On the bottom of piece No. 3, a half-inch from the front, cut a 1/16" notch the full length of the wood. This will hold the mounting board in place. Drill hole for leads an inch from the bottom of piece No. 1. Coat rear surfaces of wings, Nos. 10 and 11, with shellac, nail polish or plastic spray to help high-frequency response. Use Weldwood Contact



Tiny enclosure with tiny speaker hooked up to amplifier gives amazingly good reproduction.



Exploded diagram of the speaker enclosure indicates how parts fit together. All wood pieces are of ¼" stock, with the exception of No. 8 which is ½" Masonite to facilitate drilling the hole for the speaker. Note notch cut in piece No. 3 in which mounting board fits. Refer to bill of materials below when you cut the wings (Nos. 10 and 11).



Cement for gluing pieces. It sets immediately; no clamps are needed.

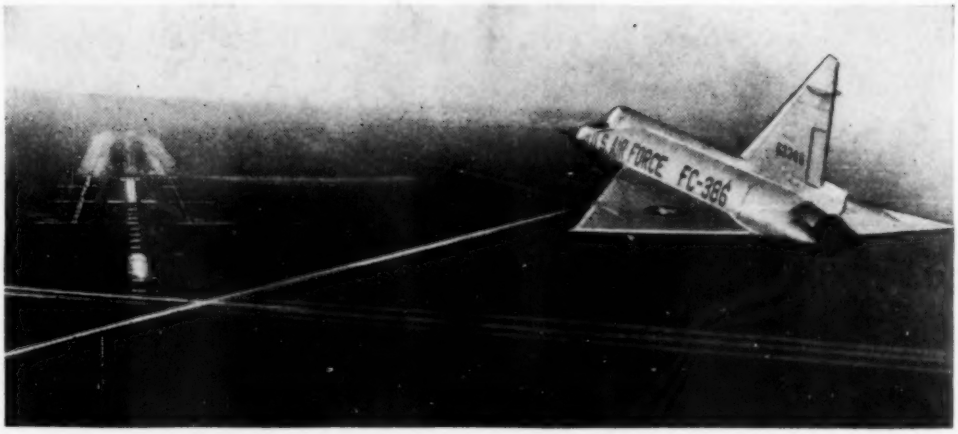
The outside surfaces of pieces No. 1, 2, 6, 7, 9, 10 and 11 can be stained any color and then shellacked. Do not shellac any inside surface (except wings) since this might cause undesirable resonance.

When connecting or trying out this little job, make sure that your amplifier volume control is set at "0" to start and then is brought *slowly* up to the volume desired. If you use the enclosure with an amplifier having bass and treble controls, set the bass for a slight boost. This will help overcome the inherent limitations of the speaker itself and give more realistic reproduction. The over-all sound quality will amaze you. Also, the volume will be much greater than usual with such a small speaker because of increased coupling between the speaker cone and the surrounding air. —30—

BILL OF MATERIALS

Piece No. 1—2½" x 3½" x ¼" wood
Pieces No. 2, 9—2" x 3½" x ¼" wood
Piece No. 3—2" x 1" x ¼" wood
Pieces No. 4, 5—¾" x 1" x ¼" wood
Pieces No. 6, 7—2" x 2" x ¼" wood
Piece No. 8—2" x 2" x ¼" Masonite (1⅜" hole in center)
Pieces No. 10, 11—3½" x 1" at top and down ⅝", then straight line to corner as in exploded diagram (¼" stock)

Miniature speaker is only 1½". Note how it compares in size with a matchbook. Mounting holes in piece No. 8 (see drawing) can be traced directly from speaker.

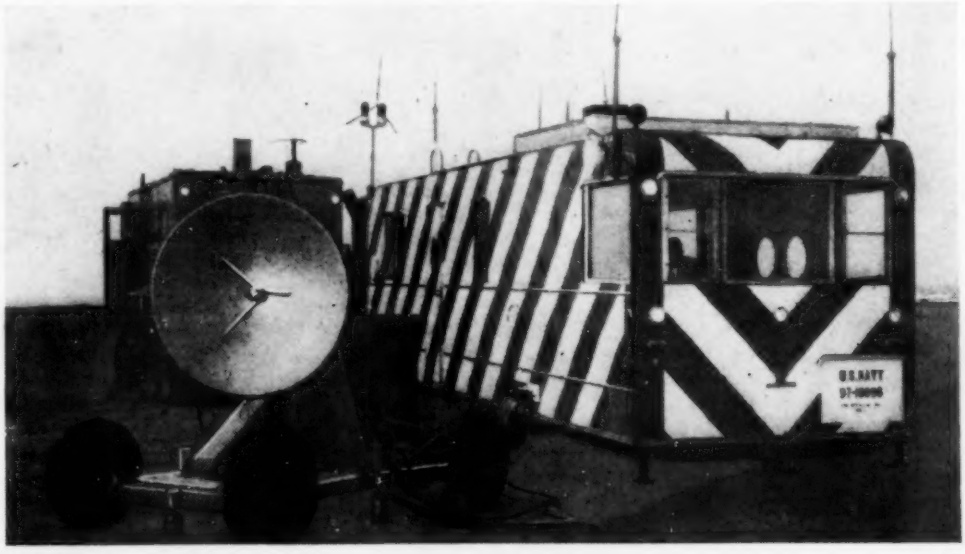


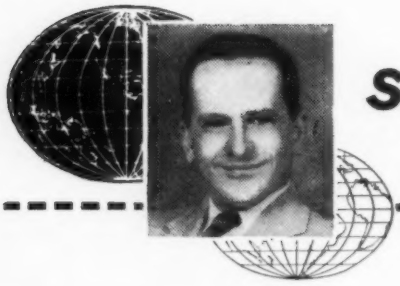
Making Landings Easier

THE PROBLEM of getting planes down safely in bad weather has been graying the hair of scientists since the Wright brothers first got a few yards above the ground. Two new aids in solving this problem are presented here.

The photo above shows the March Field runway of the U. S. Air Force lined with "the brightest strobes in the world." Each flash reaches 30-million candlepower, which is exceptional in piercing mist, fog, rain and snow. The duration of each flash is so short—1/5000th of a second—that it doesn't blind the pilot. Twenty-three strobes are installed in a center line 2400 feet out from the runway, ending just short of it. Firing of the "Strobeacons," which were developed by Sylvania, is synchronized so that each flashes in sequence twice a second. The effect is that of an ultra-brilliant ball of blue-white light streaking toward the runway at 3600 miles an hour.

To help out the U. S. Navy, Bell Aircraft has developed a combination radio and radar system which can land planes on a carrier automatically. Radar detection data is fed to a computer on the carrier which advises—via radio—the course, speed and altitude of the approaching plane. Radio receivers in the plane direct an automatic piloting device that keeps the craft under the control of the computer at all times. The system has been successfully tried out on land while mounted in the trailer shown below. The automatic landing package is now undergoing sea trials. —30—





Short-Wave Report

By HANK BENNETT

RADIO FREE EUROPE, a division of the Free Europe Committee, Inc., was organized in December, 1949, to broadcast to certain countries in Central and Eastern Europe that were under Communist domination. Programs were to be of an economic, political, and spiritual nature, and to give the listener in the target area a true story of conditions in his own country and the free areas of the world.

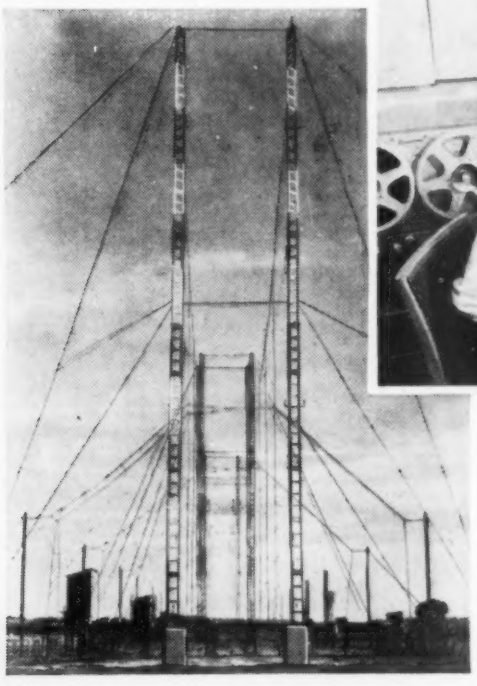
RFE is not a government-sponsored project; it is classed as private enterprise and supported largely by contributions from people who are interested in protecting the security and liberty of the United States. It is the belief of *RFE* that this end can be achieved without bloodshed or violence.

The first station was born on July 4, 1950, near Frankfurt, Germany. At that time, the main transmitter was a 7½-kw. mobile unit, housed in several trailer vans. In the following year, five high-powered units were added at fixed points in Germany. The mobile "rig" was then sent to Portugal where it became the first transmitter in what was destined to become one of the world's largest transmitting plants.

RFE stations are managed by Americans but most of the other personnel involved are people who have fled from the Communist over-run countries. For example, the announcers, producers, analysts, and monitors of the *Free Poland* section are largely Polish refugees who are able to broadcast in their native tongues. Such people are well versed in the customs and habits of their native countries and can speak about them with authority.

Much of the program material presented

(*Continued on page* 153)



This RFE monitor records the frequency, language, time of day and station of every broadcaster on the short-wave bands. The chart is then used to plot broadcast channels and to locate free channels.

Sixteen high towers stretching out for a half-mile form a directional "curtain antenna" system at RFE's transmitter site in Portugal. Thus, the radiated power of RFE's short-wave transmitters is beamed directly to the satellite countries.

Save that OLD RADIO

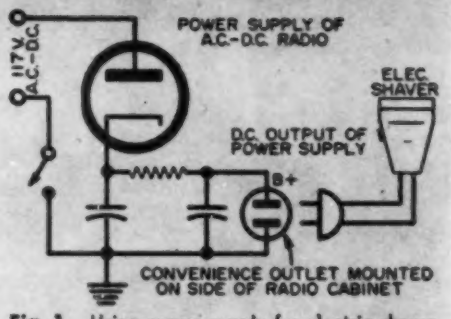

117 V. A.C.-D.C.
POWER SUPPLY OF A.C.-D.C. RADIO
ELEC. SHAVER
D.C. OUTPUT OF POWER SUPPLY
B+
CONVENIENCE OUTLET MOUNTED ON SIDE OF RADIO CABINET

Fig. 1. Using power supply for electric shaver.

You've got a gold mine in current converters and parts waiting to be used

DON'T LET the little woman toss out that old radio! It's full of nuggets waiting to be dug. You can pan for gold in two ways—either use the radio as is or rip it to pieces and salvage the parts. First, we'll show you how to use the old set itself.

Let's start with the power supply. By bringing out a pair of leads to an outlet mounted on the side of the cabinet, you have an electric shaver pepper-upper. It's a fact that such shavers work better on d.c. than a.c., so here's a chance to be kind to your shaver—and your face (Fig. 1).

Need a "B" battery for testing your portable set? The power supply is the answer. Simply connect a 10,000-ohm wire-wound potentiometer across the output and tap off any voltage up to the maximum (Fig. 2). Make sure you disconnect the primary of the output transformer of the old set in order not to overload the rectifier.

When hearing-aid batteries become weak, they may be given a new lease on life by recharging them with the power supply. This charge is generally good for several days, and may be repeated several times before the batteries are worn out.

Does the antenna changeover relay on your transmitter buzz? Why not operate the relay winding on d.c. instead of a.c. (Fig. 3), and work in quiet? And don't go

By
JOSEPH LEEB
and
WM. B. RASMUSSEN

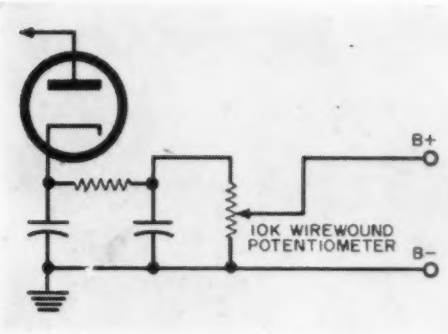


Fig. 2. Need a "B" battery to test your portable? Here's how to tap off any voltage you want.

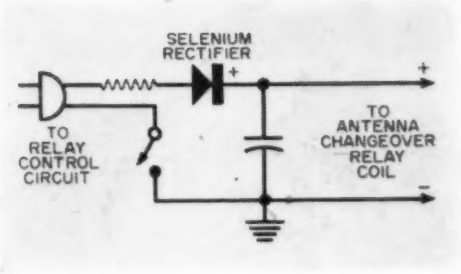


Fig. 3. Operate your antenna changeover on d.c. to eliminate buzz, using this simple circuit.

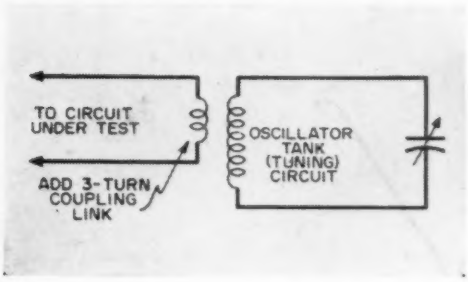


Fig. 4. Oscillator can furnish substitute signal to test another set whose oscillator is out.

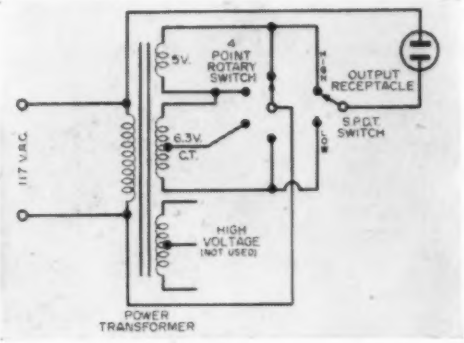


Fig. 5. This is the way you can make an autotransformer for testing under extreme conditions.

away yet. Still at the power supply, you can test a filter or bypass capacitor by connecting it between B+ and ground for a few seconds. Then remove it and short it with a screwdriver. If the capacitor is good, you'll get a spark—the size of which depends on the size and quality of the part. Remember that in charging an electrolytic capacitor the positive goes to B+ and the negative to B— or ground. Don't apply more than the rated voltage to a capacitor.

Let's suppose your wrist watch has been giving you trouble. Don't run down to the jeweler so quickly. It might just be magnetized. You can remedy that by connecting the field winding of the electrodynamic speaker (3000 ohms or so) to the a.c. power supply. Suspend the erratic watch near the magnet core for a few seconds and presto! It's as good as new again. You can also demagnetize drills, screwdrivers and such in the same way.

Or suppose you need a signal generator to test a receiver whose oscillator is not working. The oscillator in the old set can furnish the substitute signal if you simply add a three-turn coupling link (Fig. 4).

If the salvaged set happens to be an a.c. job using a power transformer, that part can be connected as an auto-transformer to deliver voltages higher or lower than line voltage. This comes in handy for testing radios, TV sets and other devices under simulated extreme line voltage conditions, or for compensating for line voltage variations in the workshop (Fig. 5).

Does your small electric drill turn too fast? You can vary its speed easily by connecting it to the line in series with an a.c. radio, and removing the tubes one at a time until the proper speed is reached. It works like a rheostat (Fig. 6).

If the power transformer should be burned out, don't discard it—the laminations in the core are fine for scraping down your workbench, removing enamel insulation from wires, and cleaning snow and sleet from windshields. The laminations can be cut into BX cable clamps, angle brackets, windowpane nails, and so forth.

Like to trouble-shoot? An old receiver makes a swell signal tracer. Simply build a probe (Fig. 7), connect it to the grid of the first audio stage of the old

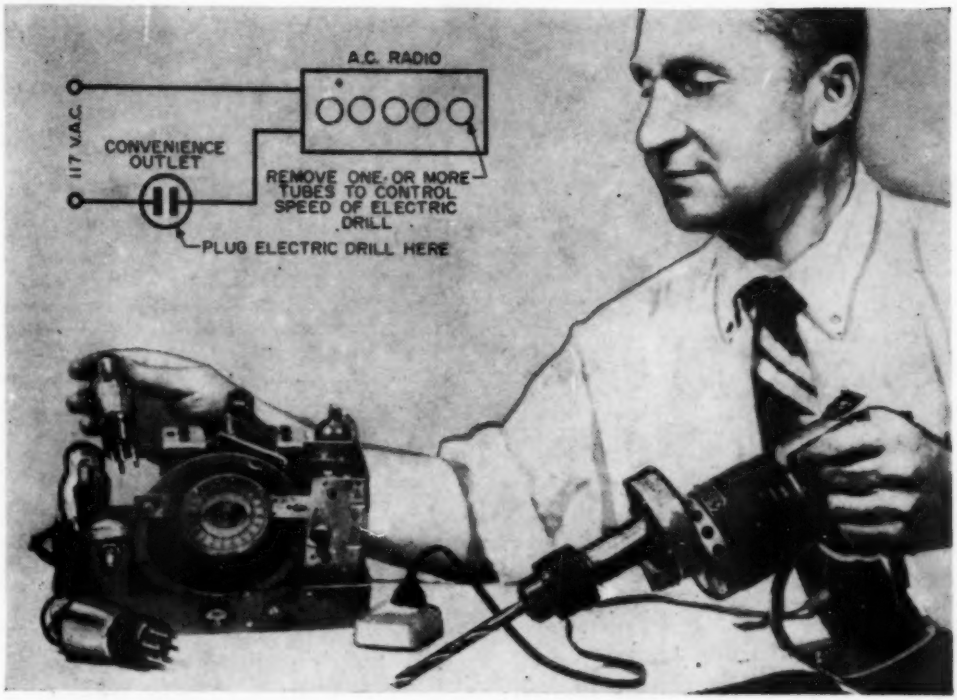

A.C. RADIO
117 VAC.
CONVENIENCE OUTLET
REMOVE ONE OR MORE TUBES TO CONTROL SPEED OF ELECTRIC DRILL
PLUG ELECTRIC DRILL HERE

Fig. 6. You can connect a power tool in series with the radio and vary its speed by removing one or more tubes. Just hook up a convenience outlet to the outside of the set as shown.

set, and get to work. The signal in any portion of the set under test can be picked off by means of the probe and converted into an audible or visual signal by means of your signal tracer. If the signal in question is r.f., it is rectified by means of the diode and changed to a.f. If the signal is a.f. to begin with, the radio signal tracer merely amplifies it.

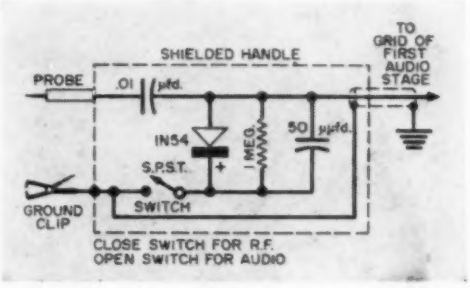


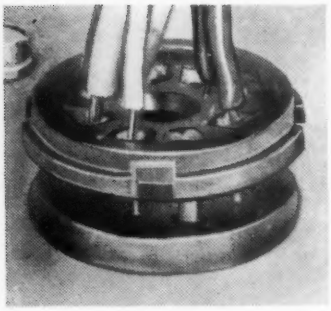
Fig. 7. Making a signal tracer out of the radio.

But let's say you want to take the old set apart for salvage. You need the parts, and the set is not worth repairing. Of course, you know the ordinary components, and of course you're going to salvage them. But there are some other things you can salvage from such a set so that when you're through it will look like a skeleton picked clean in the desert.

First of all, salvage the cabinet if it's a console. You can refinish it with shelves as a storage cabinet or it can house audio equipment. You might cut off the legs and eliminate the gingerbread, and perhaps repaint it. It's fine workmanship, probably, so make use of it.

An old vacuum tube has many unorthodox uses. You can use the base for a cable plug, or a component such as a selenium rectifier can be wired onto the tube base. Then the component can be easily inserted into a circuit by plugging it into a tube socket.

The individual pins to the tube base can be removed by cracking the base. The pins are a source of small bore tubing. Or they can be used as cord tips in conjunction with contacts from tube sockets. The envelope of a metal tube can be useful for housing or shielding miniature components. By taking a tube

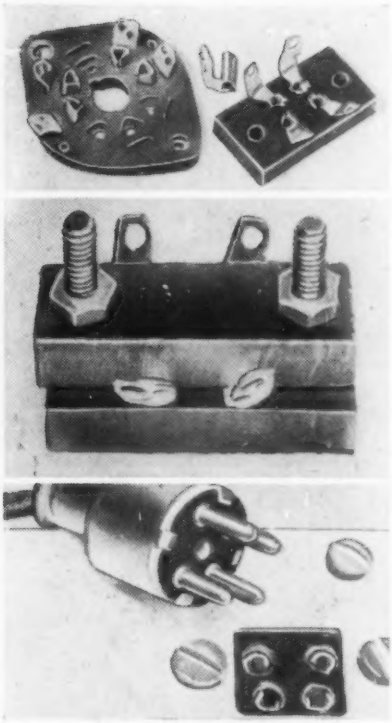


An old tube base can serve as a cable plug, or a component such as a selenium rectifier can be wired into it and plugged into circuit in tube socket.

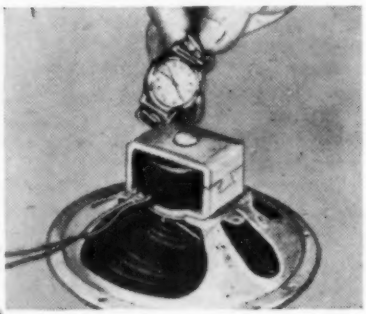
apart, removing the "guts," then reassembling with transistors and other miniature components inside, a plug-in module can be made.

Tube sockets in old-timers are generally of the wafer type. The contacts can be used in a variety of ways. For example, specialized sockets can be made. In the combined photos at left is one such socket. It is for a record changer which utilizes a four-prong plug for connecting to the preamp. The correct spacing for holes in the socket was made by pressing a piece of paper on the plug, then transferring it to a Bakelite socket. Holes large enough for the contacts were then drilled in the Bakelite. The contacts, shaped as shown at top, are held in place by a second Bakelite piece (center). When assembled in the chassis (bottom), this home-made socket looks quite professional.

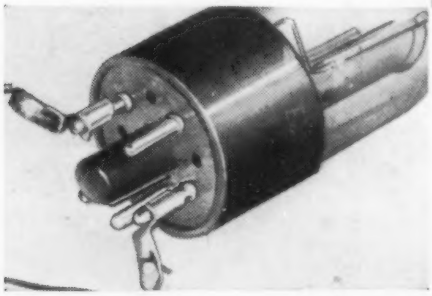
The contacts are also useful in making temporary hookups to vacuum tubes. In the same way, test prods can be connected to contact-tipped wire leads. Or, by using pins from tube bases as cord tips and socket contacts for tip jacks, simple connectors might be made. Then, when breadboarding a circuit, a number of random-length wires equipped with connectors could be very handy. The contacts could be used to establish permanent test points in electronic circuits to facilitate taking meter readings. -30-



Contacts for specialized sockets are shaped as shown in top of three photos. They are held in place by second piece of Bakelite (center). When assembled in chassis (above), socket looks professional.



You can demagnetize a watch by connecting the field coil of an electrodynamic speaker to a.c. (above), and suspending your watch near core.



Tube base pins can be used to make temporary hookups to vacuum tubes (left). You can also make cord tips and socket contacts from the pins.

AFTER CLASS

Special Information on Radio, TV, Radar and Nucleonics

ELECTRONIC LOGIC

"I've been told that electronic computers are really quite simple devices—that the individual circuits are elementary, and that the complexity of a computer results from the vast number of basically identical circuits used. Is this true?"

COMPUTERS are essentially simple devices, in spite of the fact that they solve problems of such intricacy and detail as to stagger the imagination. They read the problem, do their calculating, and write the answers at speeds up to a million times faster than the human eye, brain, and hand can together do the same task.

Naturally, they are very complex. Even Simple Simon, one of the smallest training computers ever built, has over 120 multiple-contact relays in addition to a host of push buttons, switches, and indicator lights. But from ENIAC to ERA 1103B (the most recent version of Remington Rand's famous UNIVAC), they all perform common basic operations. It's fun to see how really simple some of these basic operations are.

Complicated Simplicity. First, consider the logical concept "and." Suppose that a complicated multiplication of large numbers having the product *A* is to be added automatically to some other product *B*. The addition mechanism of the machine must not be permitted to start operating until *A and B* are both registered in its storage section.

Thus, the electrical conditions call for a circuit which will yield an output signal only if *both A* and *B* have been fed to it as input signals. Vacuum tubes, gas tubes, transistors or relays may be set up to perform this logical step. Figure 1 illustrates a relay "and" circuit, while Fig. 2 shows how it would be done with a vacuum tube.

In Fig. 1, coil *C* cannot be energized unless both *A* and *B* armatures are down. Whether *A* and *B* are self-latching relays or not depends entirely upon the kind of operation desired. If the problem is such that *C* is not to pull-in unless both *A* and *B* arrive *simultaneously*, the relays will not be self-latching. On the other hand, if *B* is to count regardless of the interval between its arrival and *A*'s registration, then *A* would latch-in after being energized and remain that way until the signal which activates *B* is received. Contacts on relay *C* could be used to reset the others.

The vacuum-tube version shown in Fig. 2 is one that is found throughout ENIAC (*E*lectronic *N*umerical *I*ntegrator *A*nd *C*omputer) and is called a *gate*. It consists

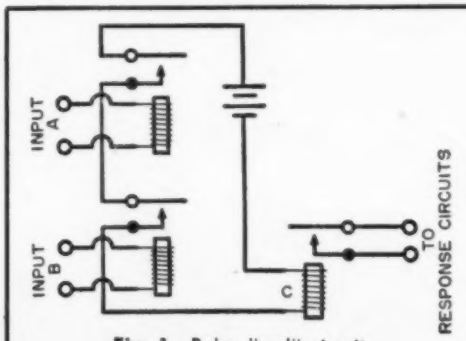


Fig. 1. Relay "and" circuit.

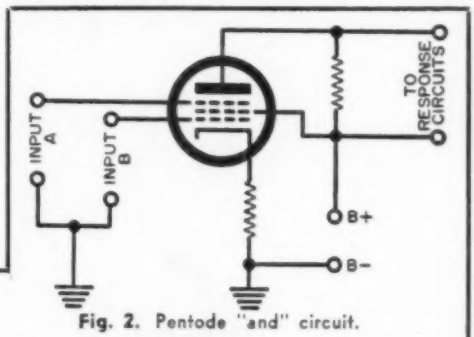


Fig. 2. Pentode "and" circuit.

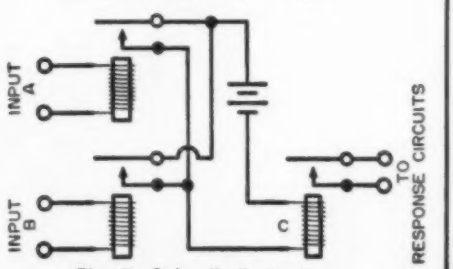


Fig. 3. Relay "or" circuit.

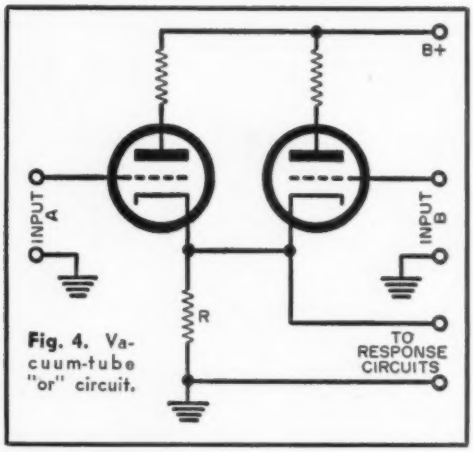


Fig. 4. Vacuum-tube "or" circuit.

of a pentode with the incoming signals applied to the control grid and the suppressor grid. Both of these grids are biased negatively so that plate current can flow in the anode circuit only if *both grids* are driven positive by the incoming signals *simultaneously*. This is an "and" circuit analogous to the non-latching relay arrangement discussed before.

"Either-Or" Circuits. In calculating the net income of a corporation from sales *A* and from dividends on stocks *B*, two different arithmetical computations may be going on simultaneously in the "arithmetic" section of the machine. Both sets of results must be combined in summing up the corporation income regardless of the sequence in which the results are obtained in the calculating organ of the computer. This demands that *either A or B* have the ability to trigger the adding mechanism; hence, the circuit which performs this operation is called an "or" configuration. Figures 3 and 4 respectively show the relay and vacuum-tube version.

In Fig. 3, one side of *C* is always connected to its voltage source and the other terminal is wired to the lower contacts of *A* and *B*. When either of these two are activated, relay *C* operates, establishing the required "or" condition. Both tubes of Fig. 4 have a common cathode resistor. If either one is driven into conduction by a positive-going incoming signal, a voltage pulse will appear across *R* and can be utilized as output to trigger the next stage.

Information Storage. Like the human brain, a calculating machine must be able to remember what has gone before to combine it with what is now coming in or is yet to come. Machine memory may be set up in many different ways: banks of vacuum tubes and lights arranged in rows and columns (ENIAC method); paper tapes punched out in a machine code (IBM Selective Sequence Calculator); magnetic cores of the ferristor type (ERA, current models); electrostatic storage in cathode-ray tubes of the long persistence type (ERA, original models); magnetic drum storage (ERA, current models); or mercury delay-line tanks (UNIVAC, original and recent models).

From the listing above, it is evident that the "memory" of a computer is nothing more than the storage of bits of information in the form of tubes which are *on* or *off* (conducting or non-conducting), relays that are down or up, a hole or a "not-hole" in a tape, a magnetic pole or the absence of one on a given spot on a metal drum, a

(*Continued on page* 146)

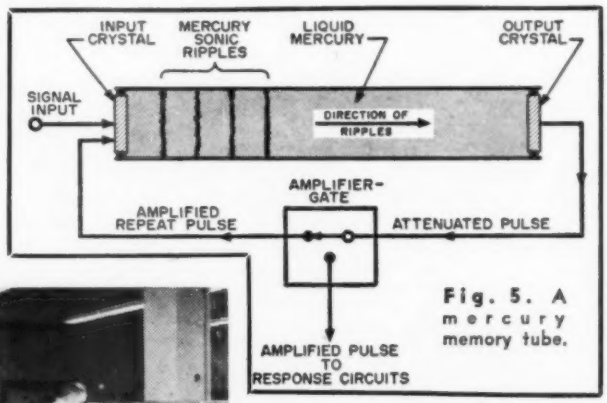
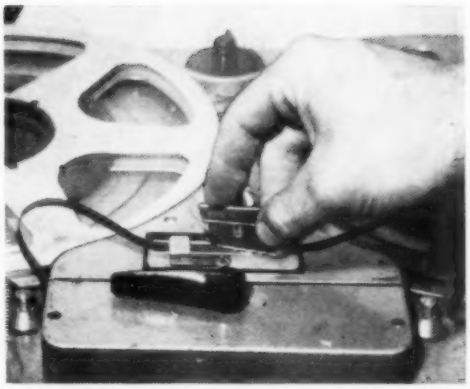


Fig. 5. A mercury memory tube.

A computer in action. The mercury memory of Remington Rand's UNIVAC is inside the Central Computer cabinet shown in background.

Getting the Most Out of Tape



Use a splicing block to make loop of tape to determine exact speed of your recorder. It may be in error.

ARE YOU completely satisfied with your tapes? Do you feel you're getting the most in sound quality for the money you invest in equipment and tape? Maybe! Here are a couple of tips which may make you change your mind.

First, how about the speed of your recorder? If your machine is running fast or slow, chances are that you've never noticed it. But if you run someone else's tapes on your recorder, or your tapes on another machine, you can be sure it'll be evident in a change of pitch or tempo. A simple way to determine the actual speed of the recorder is as follows:

Carefully cut a piece of blank tape five times the length of the rated speed of the machine, adding a quarter inch for splicing. (For instance, a 7.5-ips speed takes a length of 37½" plus ¼", for a total of 37¾".) Square both ends, overlap a quarter inch, make a diagonal cut, and splice in the usual way. Thread the loop into the recorder so that it can run continuously without interruption. Then switch to record and turn the gain up half way. Thump the mike once with your finger and stop, so it won't be erased on the next turn. Now switch to playback and count the total number of thumps in 120 seconds.

The number of thumps divided by Factor A gives the actual speed of your recorder; for a rated speed of 15 ips, Factor A is 1.6; for 7.5 ips, 3.2; for 3.75 ips, 6.4; for 1.875 ips, 12.8. Assuming a rated speed of 7.5 ips, you should count 24 thumps in 120 seconds at true speed (24 divided by 3.2, which is Factor A for that speed). One thump more or less shows a 5% deviation in speed, usually detectable only by the critical listener. If the variation is more than that, it should be corrected.

Use an oscilloscope after splicing two brands or grades of tape to find which one has better quality.

Secondly, recording tape is available in a wide variety of brands and price ranges: the following is a simple comparative test which demonstrates the relative output of any two tapes, and will help determine which is more suitable.

Splice two sample lengths (3' to 5') of any two brands, after marking them for identification. Run this sample through with a steady signal at the input—or vary it by using a voice or music passage. Splice the free ends to make a loop. Then put it in the machine and play it back. When measured with an oscilloscope or a VTVM, the relative outputs of the two tapes can easily be compared. You can also determine the frequency response of the tapes and your recorder.

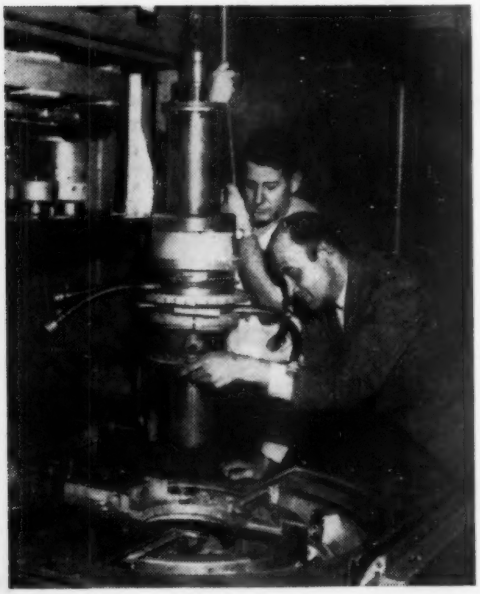
Even without these devices, you can judge fairly critically by ear. You may, perhaps, whistle a steady note into the mike and listen carefully to the playback. Of course, your own judgment will be the critical factor in this case, but since you are doing it for yourself, that's the only thing that counts.

One or both of these tape "tricks" should increase your listening pleasure manyfold.

—Warren J. Smith

Clear as Crystal

A Bell Telephone Labs scientist has developed a new ferroelectric material (above) for use in electronic computer switching circuits and memory devices (see page 89). Triglycine sulphate, the new crystal, is superior to the older barium titanate in that it permits repeated switching with a lower voltage and no fatigue. It will retain polarization indefinitely without deterioration. There are only a few materials available with ferroelectric properties and the search for such materials is constantly under way at Bell.



"Bambinophon"

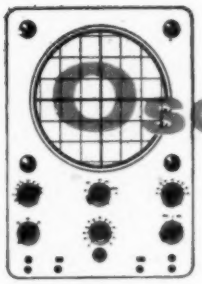
Looking for a new way to keep the little one quiet? Try the "Bambinophon," newest toy on the German market (Dr. Windhaus & Co., GmbH., Duesseldorf, West Germany). It's a transistorized tape recorder that works from flashlight batteries (having a life of about 18 hours) and uses regular magnetic tape. It plays from 3 to 10 minutes, records through a carbon mike (see photo below) and plays back through headphones or via plug-in jack to a radio.

Biggest Transmitter

Single-sideband design has aided the U. S. Army Signal Corps in developing the most effective short-wave transmitter in the world. About 50 times as strong as the most powerful commercial station, the rig's effective power is 24,000,000 watts. Key to this power is a 150-pound vacuum tube built by RCA, shown at the left being installed for Pentagon use. The operator turns a single switch to tune up on one of 10 preset frequencies. SSB design permits the "World Spanner" to handle 64 teletype messages or four separate voices at the same time.

Color-TV Course

A complete color-TV correspondence course, using the step-by-step approach, includes latest data and procedures for servicing and maintenance of all color receivers. Information and catalog are available from Radio-Television Training Association, 52 East 19th St., New York City.



Oscilloscope Traces

Parasitics

These "parasites" can be electronic "bloodsuckers"—here's how to catch them

By HOWARD BURGESS

A GOOD WAY to locate and fix trouble in gadgets and machinery is to poke around in them. So far as electronic equipment is involved, fine "poking" can be done with oscilloscope probes; once you get your 'scope on the scent of trouble, it will easily track down the cause. In the preceding articles of this series, we have gone "hum hunting" with our trusty 'scope and explored the mysterious byways of a power pack (September and August issues, respectively). This time we're after some nasty bugs: the parasitics. And next month we'll ride the square waves.

High-gain, wide-range amplifiers often have a tendency toward parasitic oscillations. These oscillations, with frequencies often well above the audio range, can be very difficult to detect. Like any "parasites," they steal their power from the system upon which they thrive—and sap its strength. Although a parasitic oscillation may not be audible as such, it shows up as lowered output, distortion, or both.

Burst-Catching. Parasitic oscillation can take several forms. One type takes the form of sporadic bursts. This happens when voltage and bias conditions in the amplifier are not favorable to the oscillation except at one point in the audio signal cycle. If this type of parasitic is

The test setup in the author's laboratory tempts his daughter Suzanne to do a bit of knob-twisting. But the twig is bent in the right direction: we need more girls in electronics.

present, oscillation occurs only when a signal runs through the amplifier.

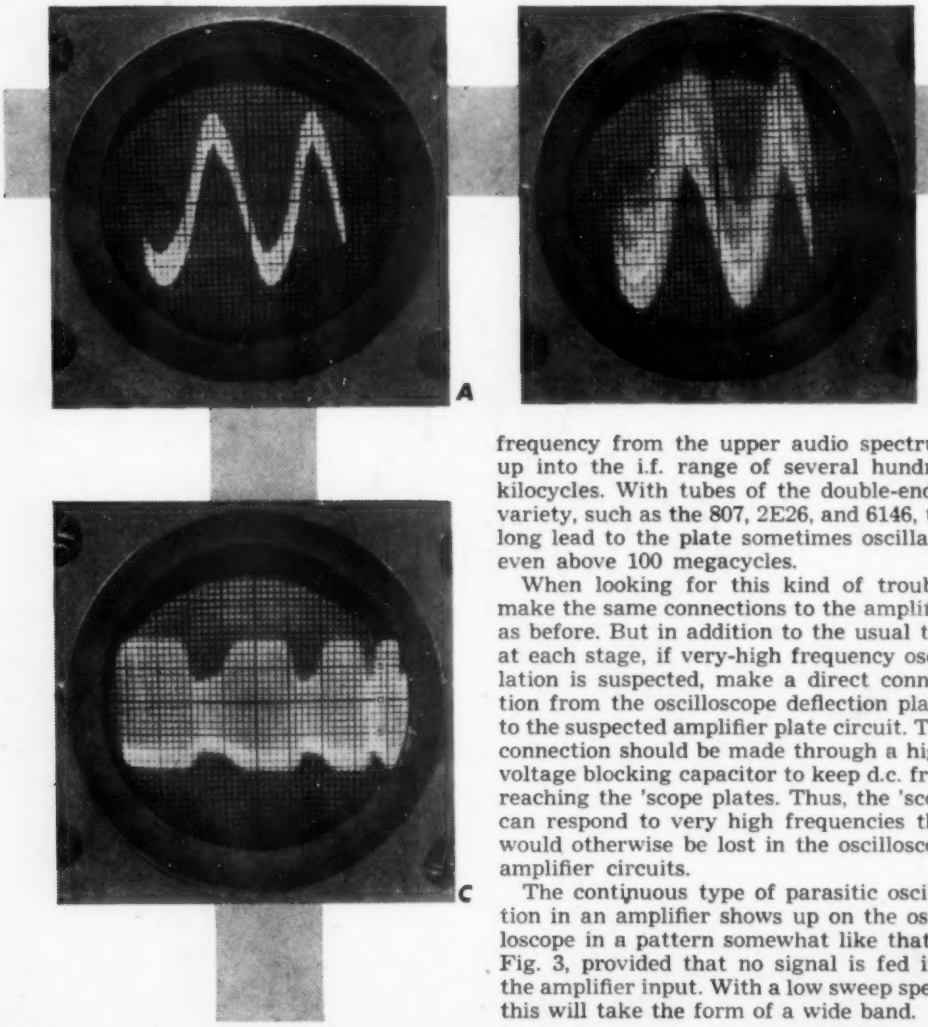
When the level of the input signal reaches a critical value, a burst of oscillation develops. As the input signal level increases above this sensitive region, the oscillation subsides. The process is repeated in each cycle of the audio input signal. Although this particular brand of parasitic is very difficult to diagnose without a 'scope, with one it becomes a simple routine.

Figure 1 shows an audio signal applied to the input of the amplifier under test. If the amplifier is operating properly, the identical waveshape will occur, varying only in amplitude, as it travels through the amplifier. If conditions in one or more stages tend to generate the burst-type of parasitic, the pattern will develop nodules or blotches like those in Fig. 2.

In using the oscilloscope, the connection to the amplifier under test should be made with a low-capacitance lead or probe. If too much capacitance is present in the 'scope connection, merely hooking the 'scope to the amplifier can kill the effect for which we are looking. A test should be made at the input and output of each stage of the amplifier. During the test at each of these points, the input audio signal level to the amplifier should be varied from minimum to the maximum useful value.

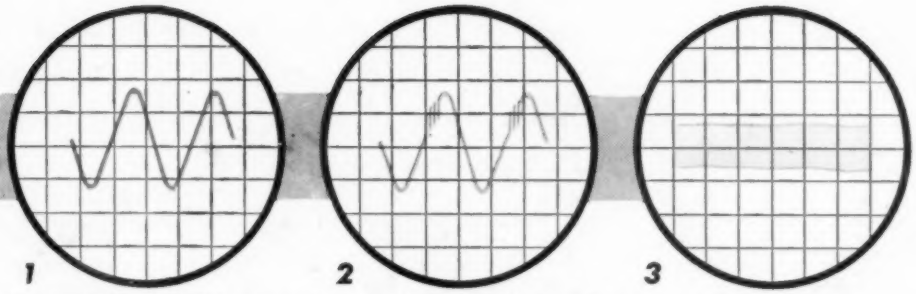
Permanent Fuzz. In the second form of parasitic oscillation, the amplifier oscillates all the time, regardless of the signal input. A very low level of oscillation may pass unnoticed in some cases or cause only a small amount of distortion. Yet in other cases the level of oscillation can be so great as to block the amplifier entirely.

The parasitics developed in high-gain, resistance-coupled amplifiers may range in frequency from the upper audio spectrum up into the i.f. range of several hundred kilocycles. With tubes of the double-ended variety, such as the 807, 2E26, and 6146, the long lead to the plate sometimes oscillates even above 100 megacycles.

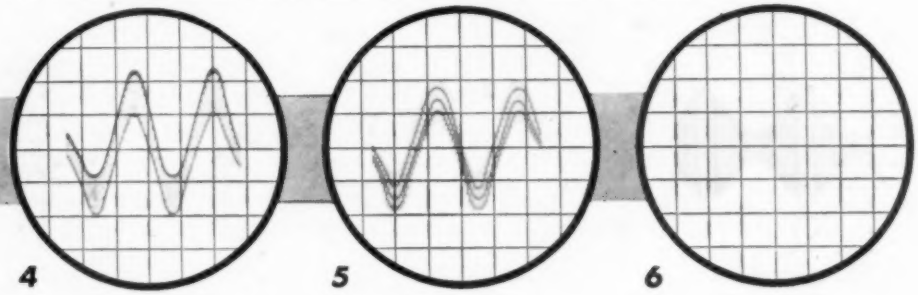


When looking for this kind of trouble, make the same connections to the amplifier as before. But in addition to the usual test at each stage, if very-high frequency oscillation is suspected, make a direct connection from the oscilloscope deflection plates to the suspected amplifier plate circuit. This connection should be made through a high-voltage blocking capacitor to keep d.c. from reaching the 'scope plates. Thus, the 'scope can respond to very high frequencies that would otherwise be lost in the oscilloscope amplifier circuits.

The continuous type of parasitic oscillation in an amplifier shows up on the oscilloscope in a pattern somewhat like that of Fig. 3, provided that no signal is fed into the amplifier input. With a low sweep speed, this will take the form of a wide band. (If



The test signal should appear the same at all take-off points from input to output (Fig. 1). If the burst type of parasitic oscillation is present (Fig. 2), little blotches or nodules are formed on the pattern. The continuous type gives a wide band on the 'scope (Fig. 3) when no test signal is present. Figure 4 shows a continuous type of parasitic with a test tone also in the amplifier. To obtain the trace in Fig. 5, the conditions were the same as for Fig. 4 except that different frequencies were involved. When combined with test signals, continuous oscillation sometimes resembles a modulated carrier, as in Fig. 6. On the facing page are actual photographs of cases (A, B and C respectively) whose salient features are emphasized in Figs. 4, 5 and 6.



the 'scope can be set at sufficient sweep speed, or if the oscillation is relatively low, the 'scope may be able to show the waveshape of the parasitic; in this way, its approximate frequency can be determined.)

Nasty Mixtures. With an audio test signal fed into the amplifier input, the resulting 'scope pattern will be a composite waveform containing both the outside test signal and the internally generated parasitic. This can take several forms, depending on the operating characteristics of the amplifier and the frequencies involved.

Figure 4 shows a 400-cycle audio test signal in an amplifier containing a parasitic oscillation at about 30 kc. In Fig. 5, the test tone input to the amplifier was changed. The change in pattern is apparently due to a harmonic relationship between the test signal and the parasitic oscillation.

Such oscillation can mix with the test signal under certain conditions to create patterns such as that in Fig. 6. This is very similar to the waveshape of a modulated carrier. In a sense, that's just what it is. Here, the "carrier" was a parasitic oscillation just over 100 kc., and the modulating audio frequency was the 400-cycle test tone fed to the amplifier input. In this case, distortion of the audio test tone was severe.

Finding and Fixing. When looking for parasitic oscillations, it is well to suspect several sources: (a) very-high-gain amplifiers; (b) stages with long grid or plate leads; (c) tubes which show excessive heat or draw large amounts of current with no signal input. Make the connections to the 'scope with a low-capacitance probe. Construction details of such a probe will be covered in a future article.

In nearly all cases, unwanted oscillations are caused by excessive coupling between components or insufficient bypassing. When the suspected amplifier stage has been located, the parasitic oscillation can often be eliminated by merely separating grid and plate wiring. If this won't do the trick, a few micromicrofarads of capacitance from the grid or plate to ground is sometimes effective. Or a half-watt resistor of 50 or 100 ohms inserted in the grid lead close to the tube socket may possibly cure the trouble.

There are times when none of the above methods of eliminating parasitics will work and the experimenter is "on his own." At such times, it might be better to take up bird-watching as a hobby. —30—

Transistor Topics

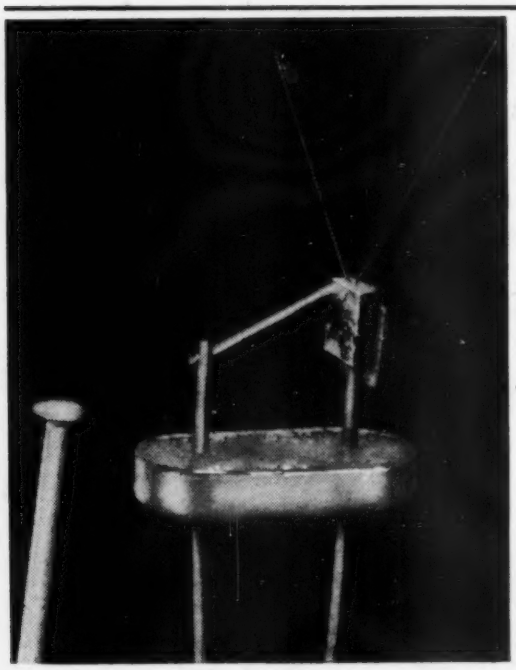
By LOU GARNER

SCIENTIFIC BREAKTHROUGH is a phrase you don't hear too often, for it identifies a startling advance in scientific knowledge or technology. Great scientific breakthroughs in electronics include such developments as the triode vacuum tube, the superheterodyne receiver circuit, radar, and the transistor. Now, three scientists of the Raytheon Manufacturing Company, Waltham, Mass., have announced a breakthrough with vast potential in the electronics field—the invention of a completely new semiconductor device.

The "Spacistor." Retaining many of the basic characteristics of the transistor —it can be packaged in minute assemblies and operates on a fraction of vacuum tube power requirements, having no filament to heat or burn out—the "Spacistor" promises major advantages over both transistors and vacuum tubes. After two years of intensive research, however, it is still in the developmental stage and may not be available as a commercial product for several years.

The Raytheon scientists predict that the unit will work as an amplifier as high as 10,000 megacycles. Because Spacistors can be made from materials unsuited for transistors, future units are expected to operate at temperatures as high as 500° C. And, unlike the transistor, the Spacistor has *high input* and output impedances. Still another of its desirable characteristics is high gain: low-frequency power gains of 70 db and voltage gains of 3000 have already been achieved with experimental units.

While the Spacistor is similar to the transistor in over-all appearance, in physical size, and in the nature of its construction, it utilizes an entirely new principle of operation. Its ability to overcome the frequency limitations of the transistor is achieved by avoiding the slow diffusion of electrons and "holes" through the base



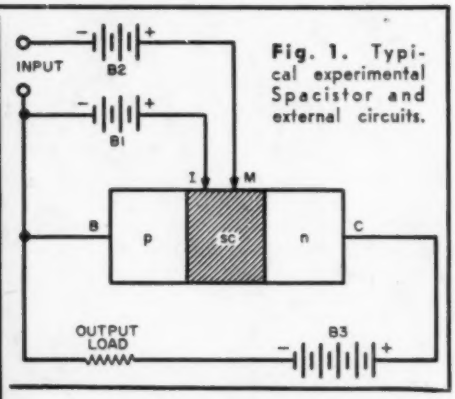


Fig. 1. Typical experimental Spacistor and external circuits.

Experimental assembly of Raytheon's new Spacistor compared in size with an ordinary straight pin. It promises major advantages over both transistors and vacuum tubes.

region. Movement of these charges across the base region of a transistor is relatively slow because this region is essentially free of strong electric fields. In the Spacistor, on the other hand, very high electric fields are used to accelerate the charge carriers so that their transit time is greatly reduced.

A typical experimental Spacistor is shown schematically in Fig. 1. The semiconductor body is a reverse-bias *p-n* junction with a "space-charge" region (*sc*). Two other electrodes have been added to the basic junction —a pressure contact *injector* (*I*) and an alloyed contact *modulator* (*M*). The injector and modulator serve as the input terminals, and the junction's *base* (*B*) and *collector* (*C*) as the output terminals.

In operation, battery *B3* applies a reverse-bias to the *p-n* junction. The injector (*I*) is biased negatively with respect to the space-charge region (*sc*) by *B1*. Electrons may be emitted from *I* into *sc*, but this emission is limited by the space charge.

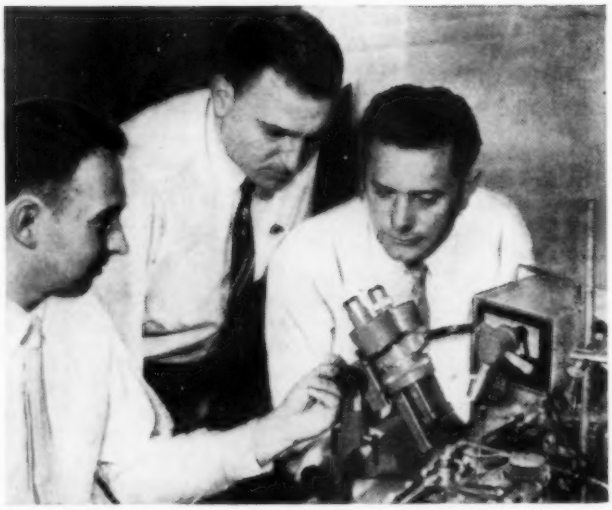
The modulator (*M*) is connected to *sc* at a point between *I* and the *n* region of the semiconductor junction. *M* is biased negatively with respect to *sc* by battery *B2*, preventing the movement of "holes" from the junction's *p* area to *sc*; thus, *M* draws practically no current.

Because of its bias and location, modulator *M* makes the bias of injector *I* practically independent of the voltage applied across the *B* and *C* electrodes, keeping the output impedance very high (in excess of 30 megohms).

When an input signal is applied to the injector and modulator electrodes, the net effect is to vary the emission of *I* by superimposing an a.c. signal upon its d.c. bias. This permits corresponding changes to take place in the base-collector current, developing an amplified signal across the output load resistor.

A comparison of how the charged par-

(*Continued on page* 130)



The Spacistor's three inventors gathered around their brainchild: Dr. Hermann Statz (left), Dr. Robert Pucel (center) and Conrad Lanza (right). Below is a comparison of the basic characteristics of the vacuum tube, the transistor and the Spacistor.

CHARACTERISTICS	VACUUM TUBE	SPACISTOR	TRANSISTOR
Frequency Limit	High *(1000 mc.)*	High *(10,000 mc.)*	Medium *(250 mc.)*
Heater Power	Required	None	None
High Temperature Materials	Available	Available	Not Available
Theoretical Life	Limited	Unlimited	Unlimited
Vacuum Envelope	Required	None	None
Circuit Weight and Space	High	Low	Low
Strategic Materials	Required	None	None
Complexity of Multiple-Stage Circuitry	Low	Low	High
Input and Output Impedances	High	Very High	Low

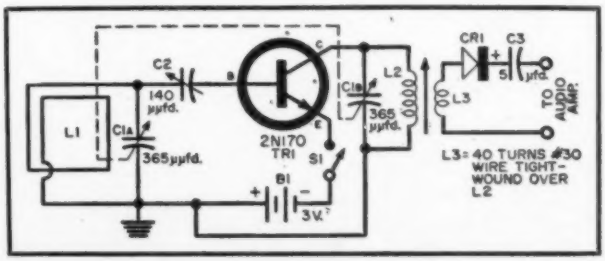
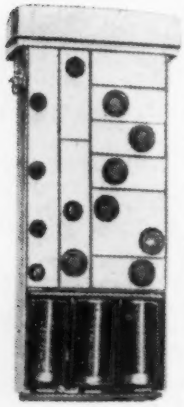


Fig. 2. Reader Larry Weill's transistorized regenerative receiver circuit. See text on page 130 for details.

Electronic Cops

New York's Finest are experimenting with RCA's 10-ounce portable transistor radio as a way to increase the policeman's effectiveness in Central Park. Working in the 15-mc. band, this receiver picks up broadcasts from about a mile away. The tiny set is worn at the officer's belt, with the speaker clipped to his collar under his ear. So far, the department has been working with a pilot model. If the tests prove successful, it is expected that cops in the parks will be equipped with receivers. The set is powered by three mercury batteries, and is completely transistorized. A crystal-controlled double superhet, it contains printed circuitry and built-in antenna. Photo at right shows the set in action, clipped to the cop's belt. At left is the radio without its case. It is 6" long, 3½" wide.

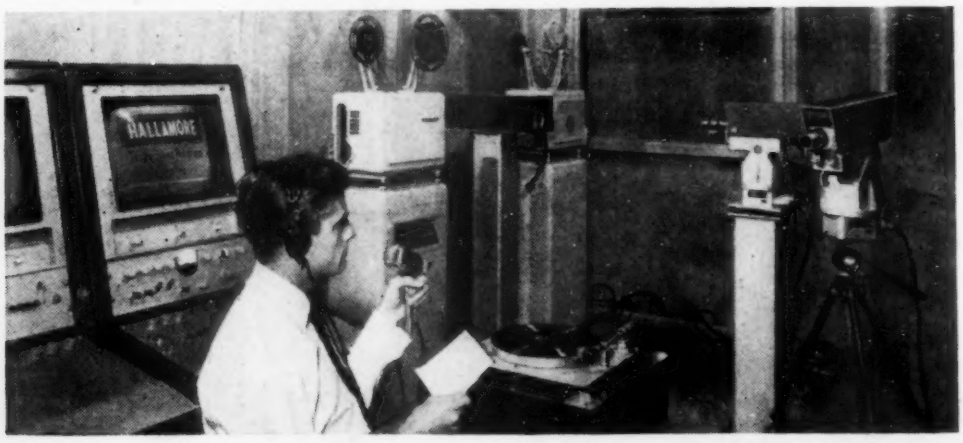


One-Man Television Studio Makes Bow

A one-man TV studio which is ideal for the community antenna operator has been developed by Siegler-Hallamore. Seated at the master control console (below), the announcer/disc jockey can run the entire show. By flipping switches and turning levers, he can operate remote cameras (at the far right) and even turn a camera on himself as he announces the news or gives commercials. He can switch from live to film to slides (projectors are in rear center) to remote telecasting without leaving his chair.

The basic package consists of a remote-controlled camera for pickup of 35- or 16-mm. film projectors, a 35-mm. slide projector, transcription turntable, microphone built into the control console for announcements, and a 10-watt high-fidelity amplifier and speaker system for true monitoring of the program line. More cameras can be added if needed, as well as more projectors.

One of the principal applications of the setup would be in closed-circuit telecasting, such as announcements and films within a plant. It could also be integrated into the entertainment programs of hotels. Total cost is under $15,000 for the package.



By ARTHUR J. ZUCKERMAN

You Too Can Be a Barbershop Quartet

ARE YOU PRONE to singing in the bathroom? Do you like to hear yourself reverberate? In that case, get out of the bathroom and become a twin, triplet, quartet, or even a glee club. It can be done with a few tape tricks.

All you need is a tape recorder, a friend with another tape recorder, a mike-phono mixer, and a pair of earphones. Then you're all set to enter the harmonious domain of "multiple recording" and become mellow, fellow.

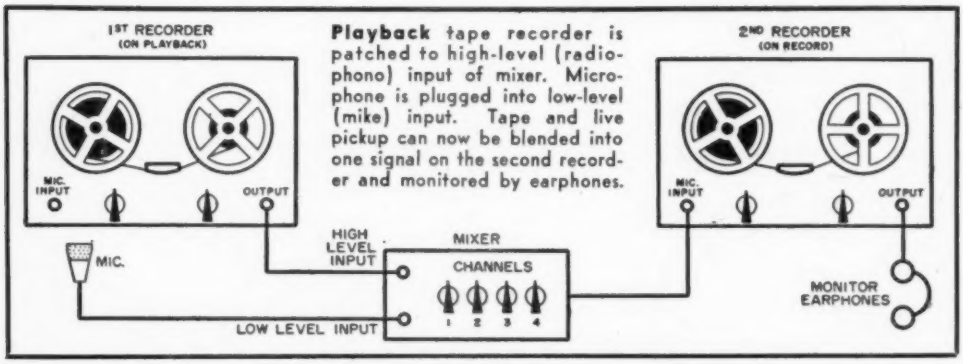
A mixer is a device with which you can literally mix the signals from one or more "live" microphones with sound from a player or radio. This combined signal is then fed into your tape recorder as a "single" program.

Instructions for making a two-channel mixer that is perfectly suited to multiple recording appeared in the June 1957 issue of POPULAR ELECTRONICS. If you'd prefer something a bit more flexible, you can buy reasonably priced four-channel mixers made by either Pentron or Masco. Each of these ready-made units permits you to mix signals from up to four microphones, or to add other sources—like phonograph and radio—to the material going into the mikes.

First Take—First Tenor. Once the equipment is assembled, you're ready to start. Want to try a one-man barbershop quartet? To begin with, plug your mike into the first recorder and make a conventional recording of yourself singing the melody of the tune.

It's best to precede the actual singing with a cueing tone. This may be simply a hummed tone, a piano chord, or even a tone made by striking a partially filled water glass with a spoon.

After you've recorded the melody, rewind the tape to the beginning. Then plug the mike into one of the low-level mixer channels. Next, connect a patch cord from the output jack of the tape recorder to one of the mixer's high-level channels. The mixer's output, in turn, is connected to the micro-



Playback tape recorder is patched to high-level (radio-phono) input of mixer. Microphone is plugged into low-level (mike) input. Tape and live pickup can now be blended into one signal on the second recorder and monitored by earphones.

phone input jack of the second recorder.

The last preparatory step is to plug the earphones into the output jack of the second tape recorder. You are now ready to start blending harmonies—you're going to get "on top of yourself."

Two Is "Accompany." The second tape recorder is started on "record," and the first machine is set for "playback." Monitoring with your earphones through the second machine, you hear the recording from the first unit as it plays through.

When you hear the cueing tone, start harmonizing with the already-taped melody. The level controls on the mixer will enable you to balance the output of the tape and the mike. It's a good idea at this stage to make a few preliminary tests in order to be sure the sound levels are in proper balance so that your harmonizing voice will blend with your melody voice.

After you've completed this first mixed recording, you'll find that you've got a tape with a one-man duet. Now, after rewinding both tapes, you're ready for the next round.

If both recorders are equalized on the same response curve, all you need do is switch tapes. However, if the two machines are not equalized on the same curve, you'd best reverse the recording setup. Machine No. 2 now feeds into the mixer, and recorder No. 1 takes the mixer's output and the earphones.

Three or Four's a Crowd. The first tape bearing the original melody is now used for recording. The duet on the second tape becomes the sound source. Proceed as before: listen for the cueing tone, and then sing the third part along with the duet.

When this step is completed, the tapes are switched once more, and the fourth voice is added. Result: one tape with a four-part harmony, sung all by yourself.

For best effects, there are a few things to bear in mind. If the tape recorders you use have high-impedance outputs for connection to external amplifiers, these are the outputs you should patch to the mixer. This will provide the best sound quality. However, if such outputs are not available, the output marked "external speaker" will do.

Always plug the mixer into the mike in-

Recording hookup as seen from rear shows mike and first recorder patched into the four-channel mixer in center of photo.

put of the machine doing the recording; never plug it into the radio-phono input. Mixers turn out the same kind of low-level signal as a microphone.

The More the Fuzzier. A great number of special effects can be created with this setup. Your own imagination is almost the only limit—except for one factor. Any recorder, no matter how fine a machine, introduces a certain degree of distortion. Thus, every new recording in the process lowers the quality of the carry-over material somewhat. You finally reach a point where countless recording so blurs the first run that the results are unsatisfactory.

It stands to reason that the better the machines you use, the more times you can re-record before this degradation effect becomes serious. If one of the two tape recorders is of better quality than the other, do all your recording on the better machine, using the other one only as the sound source. However, you can do this only if both machines have the same equalization. Otherwise, you'll introduce frequency-unbalance right at the beginning.

In most practical cases, you can just ignore these problems—unless you want to transform yourself into something like a 50-voice choir. As long as you just want to sing harmony with yourself, or become a four-handed pianist, you need only a few "double-takes" on the tape machine, and distortion remain unnoticeably low.

Output of the second recorder feeds into monitor earphones, permitting you to hear previously recorded "tracks" as you add another. Mixer is shown at left.

Prime practitioners of these tricks are guitarist Les Paul and his vocalist wife, Mary Ford. By using the procedure described here, Mary and Les—who, after all, are just two people—make their records sound like a girl's choir backed up by a whole regiment of guitars.

A final word of warning: the recorder tells no lies. And if you sound off-key, it's nothing but the awful truth. —30—

Radar Altimeter Is Read Directly from Dial

The Air Force's newest altimeter uses radar to give an accuracy within 40 feet at an altitude of 60,000 feet. It determines the airplane's altitude by sending a radar signal to the ground and measuring the time it takes to return. Unlike the usual radar altimeter, which requires an operator to read the cathode-ray scope and "interpret" it, the new device is read directly from a standard altimeter dial. Servo amplifiers can put readings on as many as three dials at once, and can feed data to recorders and other devices.

hi-fi FALL ROUNDUP

A brief survey at the beginning of hi-fi's busiest season

COOL NIGHTS and longer evenings mean more listening for the hi-fi clan. Autumn is therefore the season chosen by the equipment makers to trot out their parade of new components. There is a sort of hi-fi jamboree, known as the New York Audio Fair, held yearly in late October, for publicly demonstrating new audio gear. Not until after the Fair will we have a full picture of what's new in hi-fi. But even now it is evident that radical innovations are in store—not just face-lifting for old models.

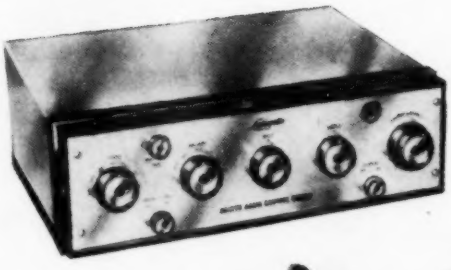
New Speaker. Big news comes from EICO, who just announced that they will make the Hegeman loudspeaker, a unique design that has been rumored among audio fans for some time. The whole speaker system, enclosure and all, takes only one square foot of floor space, and sprays out sound in all directions, including upward. The complete system will sell for $129 and thus represents a significant breakthrough on the price line for top-quality speaker systems and enclosures.

Better Tape Machines. The trend in tape recorders is an attempt to bring professional quality to the medium price range. A new Swiss machine, the REVOX, accomplishes this by mixing Swiss mechanical craftsmanship—stemming from a long tradition of precision watchmaking—with good electronic design. Though portable, the REVOX meets broadcast standards, and the use of three separate motors eliminates rubber elements such as the drive

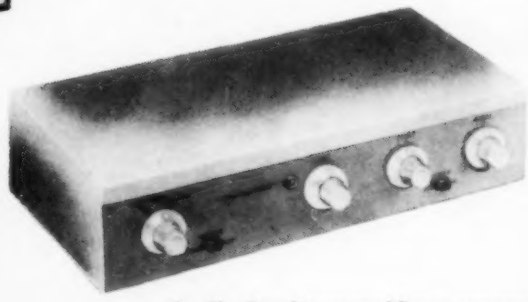
(*Continued on page* 126)

PICK OF THE RECORD RACK

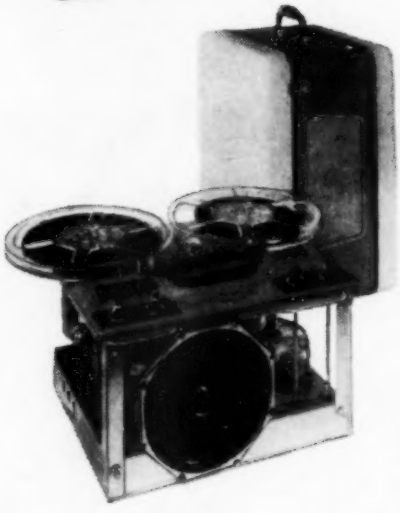
RECORD	PERFORMERS	COMMENT
R. Wagner: **Orchestral Excerpts** Westminster XWN-18453 or Capitol P-18047	Philharmonic Symphony Orchestra of London, Rodzinski, conductor (Westminster) Hamburg Radio Orch. (NWDR) Isserstedt, conductor (Capitol)	Both discs present the orchestral splendor of Wagner's passionate music in superb hi-fi, yet differ both in their musical and engineering approaches. Rodzinski is tense, electric, brightly flashing; Isserstedt more relaxed and broadly lyrical, but lacking drive. In each case, the engineers underline the conductor's tonal concept. The Westminster record is closely miked, sharply detailed; the Capitol disc more distant, with a richer over-all hue. Both are good. The choice depends on your own idea of how such music should sound.
Mozart: **Piano Concertos 21 & 27** Columbia ML-5013	Rudolf Serkin, piano Columbia Symphony Orch. A. Schneider, conductor	This is one of the rare occasions when we feel like shouting from the housetops: "Don't miss this one!" The players' hearts are evidently in their music, and they have the skill needed to polish these gems. Their glitter and warmth are preserved for us by Columbia's best engineering. A must for Mozart fans!
"The Orchestra" Capitol SAL-8385	Leopold Stokowski conducting his Symphony Orchestra	The various choirs of the orchestra (strings, brass, winds and percussion) are put through their paces in pieces chosen for just that purpose. The standout is a glowing performance of Samuel Barber's *Adagio for Strings*, but each of the other selections is rewarding in its own right. The recording is silken with none of the shrillness that sometimes passes as "hi-fi." A highly informative and beautifully designed booklet accompanies this disc.
Tschaikovsky: **Symphony No. 6 (Pathétique)** London LL-1633	Orchestra of French Switzerland E. Ansermet, conductor	Songful melody, unstinted emotional expression, and dramatic excitement make this great score a universal favorite. If you don't know it already, don't miss it. Performance and recording are first rate.



Master Audio Control Center by Lafayette with binaural channel and dual volume control offers seven inputs for every type of cartridge, tuner, or tape. It is available either as kit (KT-300) or ready-wired (LT-30).

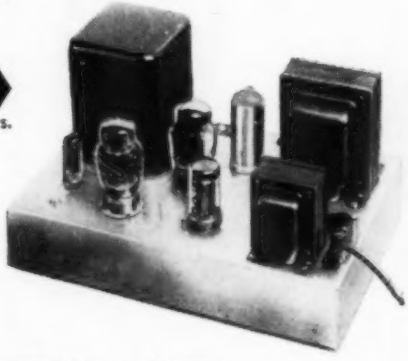


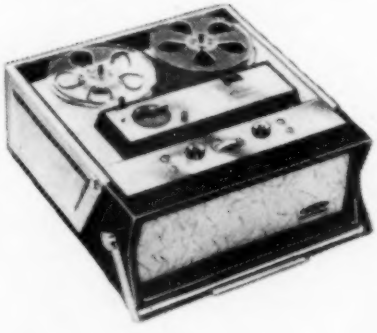
The Dynakit preamplifier, a companion to the popular Dynakit power amplifier kit, stresses utter simplicity and no compromise on sound quality.



Swiss mechanical craftsmanship is an important element in the design of the ReVox tape recorder. Note push-button controls and large monitor speaker.

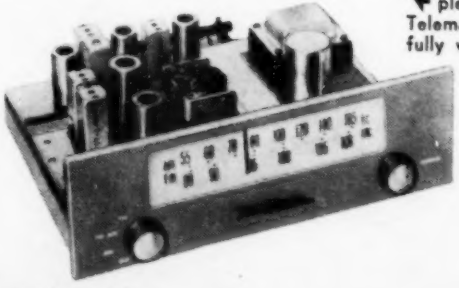
This 60-watt powerhouse by MusiCraft joins the growing family of super-powered high-quality basic amplifiers.





Pentron has completely re-designed its tape recorders, offering several models in various price ranges. This is the leader of the line.

This AM-FM tuner is part of a complete line of low-priced audio kits by Telematic Industries. It is also available fully wired or with pre-wired front end.



A complete speaker system with a 4-cu. ft. enclosure driven by an 8" coax speaker is offered by Tandberg with a face board of hand-rubbed mahogany. It can be mounted in a corner or between ceiling and wall.

Junior-Fi for the Small Fry

A few hours' work plus a little cash equal a "sound" investment

By DONALD A. SMITH

IF YOUR HI-FI has developed a split personality from double duty as a source of both "long-haired" sound for the grown-ups *and* "pop" for the youngsters, this two-evening project can be just what the doctor ordered.

Based upon the readily available RCA 45-rpm phono attachment, the completed player will prove the salvation of the hi-fi owner who has big problems with small fry. It's designed to decoy the "rock-and-rollers" away from your sensitive stylus and tender tone arm. You might even want to build extra models for your summer-house, playroom or den.

Construction time can be cut down by using one of the small preassembled a.c./d.c. amplifiers (such as Philmore's) or, if you have more ambition, you can start from scratch and "roll your own." The schematic and pictorial are here, the construction and operation have been de-bugged—let's go!

The Base. The best way to start is with an 11" x 12" plywood panel, ¼" or ⅜" thick. This is your motor board. Draw the area to be cut out as shown. Drill a large hole near the edge of the cutout, and then, using a coping saw, follow the outline shown. Next, drill the holes which will hold the changer and amplifier to the motor board.

After the motor board is complete, the front, rear and two sides of the base must be made. These are of plywood and ¾" thick.

Now for the front panel—use the illustration at right as a guide in drilling the speaker mounting holes, and cutouts for the grille. If you like, simple round holes of the correct diameter for the 4" or 5" speakers may be drilled. They can be dressed up with small squares of plastic speaker material stapled to the back of the front panel.

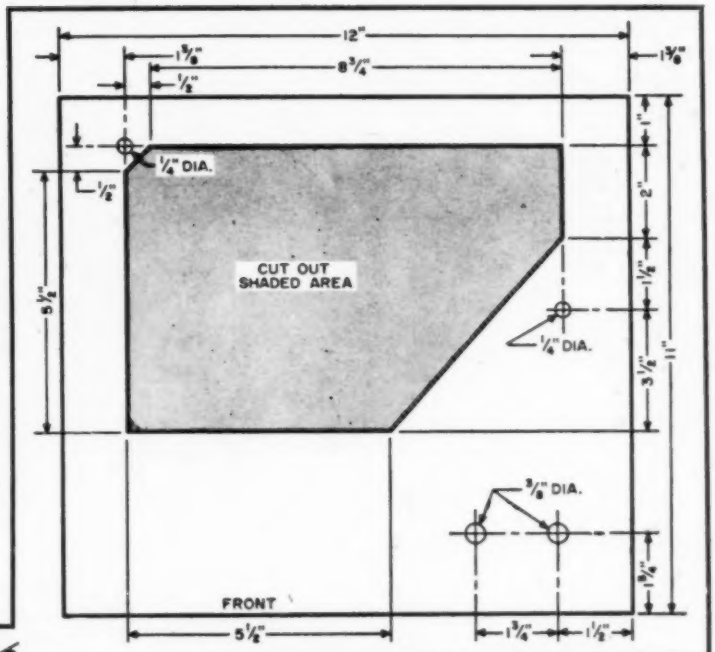
When all the wood parts of the base have been made, check them for fit. Next, sand all parts till smooth.

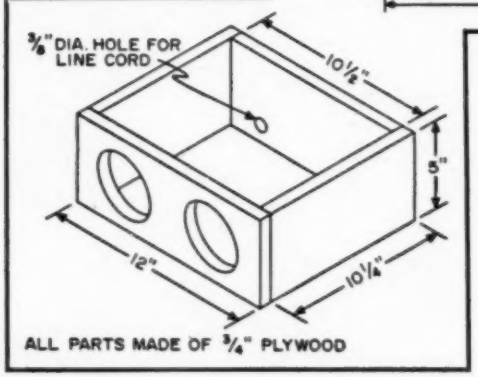
Lay out all of the pieces and glue the cabinet together using a good wood glue. Use two 6-penny finishing nails at each joint. These should hold well and allow the glue to set. Do not glue on the motor board, as it is held in place by wood screws, one in each corner. Now paint or varnish the wooden parts as desired.

Mounting Components. As soon as the base is finished and the glue dried, the electronic part of the assembly can be started. Install the speakers first. The output transformer can be held in place by one of the speaker mounting bolts.

The amplifier mounting is next. Simply

Dimensions of the top panel and base of the player are shown at right and below, respectively. The template can be used as a guide for cutout and mounting of the player. Spacing of the ⅜" volume and tone mounting holes will depend upon model of amplifier used. Butt-joint corners are shown in the plan below for ease of construction. If mitered corners are desired, the board dimensions will have to be changed accordingly. Height of the sides may be varied to match speaker size.





remove the nuts which hold the two controls, volume and tone, to the amplifier chassis and insert them through the motor board; then put the nuts and washers back on the controls.

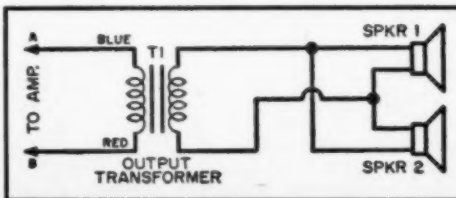
After the amplifier is mounted, remove the changer from its RCA plastic base, and install it on the new motor board. Use two of the original machine screws to attach the changer to the motor board.

Wiring. If you use a ready-built amplifier, little wiring is needed. Connect the voice coils of the speakers together in parallel or series (whichever sounds better) with two pieces of hookup wire. Connect the two thin leads from the output transformer to the voice coil connection of the speaker nearest to the transformer.

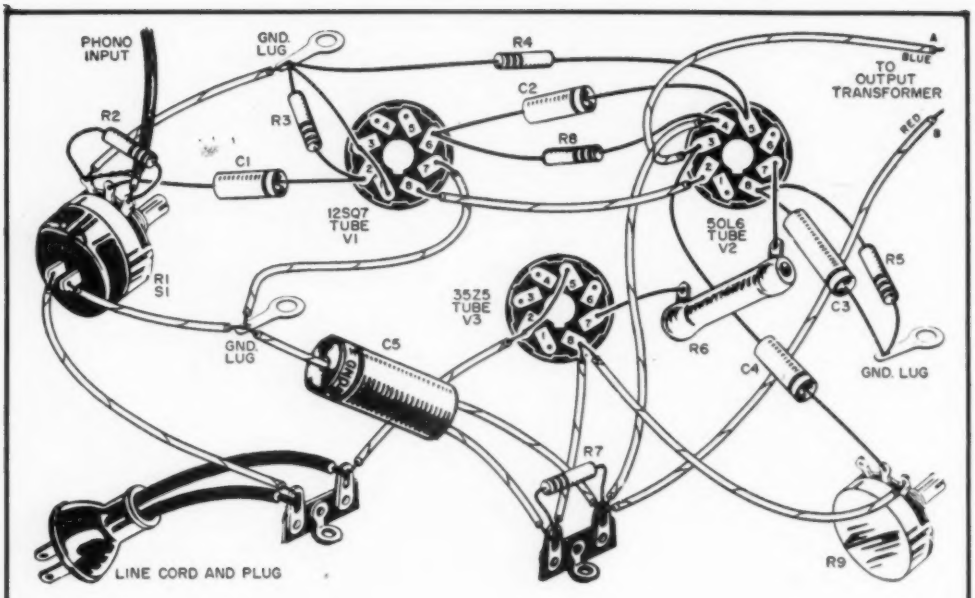
Next, cut the a.c. plug from the changer line cord and shorten the cord to a convenient length for connection to the amplifier. Solder one of the line cord wires to the chassis of the amplifier at a nearby ground lug and the other to pin #5 of the 35Z5.

The shielded lead from the changer should be about 8" long to reach the volume control of the amplifier. Connect center wire to high side of the volume control and the shield to the ground side. Now place the motor board right over—and a little above—the base, and solder the blue lead from the output transformer to pin #3 on the 50L6 tube socket and the red lead to pin #8 of the 35Z5.

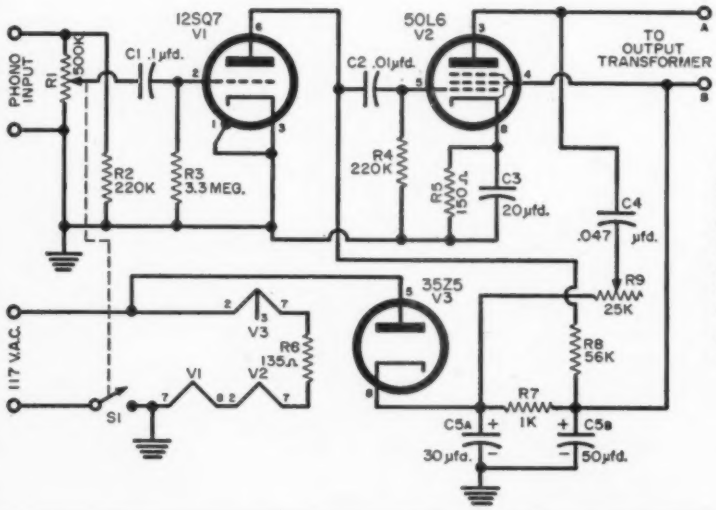
Place the motor board on the base and secure it with wood screws. Check to see that no wires are shorting to each other, and make sure that both the shielded wire running from the pickup to the amplifier and the line cord are not in the way of the



Hookup of 4" or 5" PM speakers may be made either in parallel as shown or in series (see text). Check for proper phasing by reversing the voice coil connections to one of the speakers; then note effect upon bass reproduction and connect for best results. T1 is a 50L6 output transformer. Complete phono amplifier circuit is on page 106.



C1—0.1-μfd., 200-volt tubular capacitor
C2—0.01-μfd., 400-volt tubular capacitor
C3—20-μfd., 25-volt electrolytic capacitor
C4—0.047-μfd., 400-volt tubular capacitor
C5a/C5b—30-50-μfd., 150-volt electrolytic capacitor
R1—500,000-ohm volume control potentiometer
R2, R4—220,000-ohm, ½-watt resistor
R3—3.3-megohm, ½-watt resistor
R5—150-ohm, 1-watt resistor
R6—135-ohm, 10-watt resistor
R7—1000-ohm, 2-watt resistor
R8—56,000-ohm, 1-watt resistor
R9—25,000-ohm tone control potentiometer
S1—S.p.s.t. switch (on R1)
V1—12SQ7 tube
V2—50L6 tube
V3—35Z5 tube
Misc. tie points, ground lugs, line cord, nuts, bolts, etc.



Phono amplifier circuit, above and at left, may be modified to suit constructor. R2 can be varied from 68,000 ohms up to the figure shown here. Changing the value may improve the tone of some cartridges.

changer mechanism and are well separated from each other.

As a final touch, a sheet of heavy cardboard may be cut out and glued on the bottom of the case or fitted inside of it.

Check Out. Plug your new, completed automatic record player into the 117-volt a.c. line and "check 'er out!" The fidelity of the little unit will surprise you. It's not hi-fi by any means, but its sound quality is better than a number of commercial, low-priced record players and it should prove a useful little brother to that 10- or 20-watter upstairs. —30—

Among the Novice Hams

By **HERB S. BRIER,** W9EGQ

WITH a *License Manual* and a good memory, you can probably obtain a Novice license and be on the air for months, but still know little more about radio than when you started. It is more difficult to pass the General/Conditional/Technician class examination, however, because the field of knowledge covered in it is too great to be memorized. The trick is to learn fundamentals upon which the examination is based.

This is simple to do if you study in a systematic manner, so that each new bit of knowledge adds to what you already know. Besides making it possible for you to pass the General examination (and the Novice one, too, for that matter), the procedure will increase your enjoyment of amateur radio. In the next few issues, we will discuss electronic fundamentals in a step-by-step manner, starting with the *Electron Theory.*

Electron Flow. According to the Electron Theory, all matter is composed of molecules, billion upon billions of them. Each molecule, in turn, is composed of *atoms.* The atom has a *positively charged nucleus* around which rotate one or more *negatively charged* particles, called *electrons.*

These positive and negative charges attract each other, but two like charges repel each other. In a normal atom, the two charges balance, making it electrically neutral. However, if an atom loses an electron, it is left with a slight positive charge and is called a *positive ion.* Conversely, an atom with an extra electron has a slight negative charge and is called a *negative ion.*

Things begin to happen when an electron gets misplaced. An ion that has lost an electron immediately steals one from a neighboring atom, this atom steals one from a third atom, and so on. An unwanted, extra

SEE NEXT PAGE FOR
list of those who request help in obtaining their ham licenses

electron is foisted from atom to atom with equal speed.

The importance of these electrons scooting around is that they represent electric current. *When a measurable quantity of electrons flows in the same direction for a measurable length of time, electric current is flowing.* The unit of current is the *ampere.* One ampere of current flowing is equivalent to approximately 6,280,000,000,000,000,000 electrons moving past a given

(*Continued on page* 147)

Warren Frankel, an electronics engineering student, operates as Novice KN2TIE, Rochester, N. Y.

George Purvis and his Novice station WH6CAC in Honolulu. George hopes to work the 48 states.

HELP US OBTAIN OUR HAM LICENSES

Prospective amateurs requesting help and encouragement in obtaining their licenses are listed here. To have your name listed, write to Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/WI CALL AREA

Frank Cooper (11), 6 Ledgewood Rd., West Roxbury, Mass. Phone: FA 3-1357. (Code and theory)
Robert Bridgman, 113 Hillcraft Ave., Worcester 6, Mass. Phone: PL 4-7003. (Code)
Jon Barrett (11), Husted Lane, Greenwich, Conn. Phone: TO 9-5266.
Frank Check (14), Winch Hill, Northfield, Vt. (Code and theory)
Ronald Lefebore, 510 Bernon St., Woonsocket, R. I.

K2/W2 CALL AREA

Donald J. Fass (14), 35-46 84th St., Jackson Heights 72, Long Island, N. Y. (Code, theory and selection of equipment)
William W. Dick Jr., 51-55 71st St., Woodside 77, N. Y.
Daniel Robinson, 4 Silverpine Dr., Amityville, N. Y. (Code and theory)
Kenneth Webb, 34 Silverpine Dr., Amityville, N. Y. Phone: AM 4-3195. (Code and theory)
Bruce Bouvier, Box 217, Oakland, N. J. (Code)
George Yahwak Jr. (13), 119 North St., Auburn, N. Y. (Theory)
Philip Weingarten, 335 Oak St., South Hempstead, L. I. (Code)

K3/W3 CALL AREA

Donnie Schwenk, 1104 Glen Ave., Beaver Falls, Pa. (Code and theory)
Walter B. Fisher, 930 N. Plum St., Lancaster, Pa. Phone: EXpress 2-7738. (Code, theory and regulations)
James Lester (14), 100 W. Tulpehocken St., Philadelphia 44, Pa. Phone: UL 8-5488. (Code and theory)
Miriam Houk (16), 1338 Sunrise Ave., Pittsburgh 21, Pa. (Theory)
Terry Wickham, 18 So. Buck Lane, Haverford, Pa. (Code and theory)
Richard E. Nelson, 1100 Broadway, Juniata, Altoona, Pa.
Coleman Bird, 5 Quincy St., Chevy Chase 15, Md. (Code and theory)

K4/W4 CALL AREA

Bill Carnes (13), 194 Roosevelt Dr., Commerce, Ga. Phone: 34666. (Code and theory)
Stuart Looney (19), Box 1043, Grundy, Va. (General Class code and theory)

K5/W5 CALL AREA

Truett Tidwell (15), 925 Ralph St., Grand Prairie, Tex. (Code and theory)
Danny Earhart (11), 5311 Emerson Ave., Dallas 9, Tex. (Code and theory)
Brian Johnson (11), 5436 Glenwick, Dallas 9, Tex. (Code and theory)
Richard Stone, Rt. 2, Box 75, Burleson, Tex. Phone: JE 5-9910.
Douglas Hainline, 2906 Carrolton, Houston 23, Tex. (Theory and selection of equipment)
William N. Thomas, Star Rt. 2, Box 31, Anahuac, Tex. (Code and theory)

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John Kulli (15), 556 Prospect Blvd., Pasadena, Calif. (Theory)
Jon Greene, 13913 Casimir Ave., Gardena, Calif.
Bob Alexander, 920 Grove Ave., Atwater, Calif. (Code)
Charles Cross, 1032 North Ave. 50, Los Angeles 42, Calif. (Code and theory)
Randall K. Kirschman, 1725 Franck Ave., Santa Clara, Calif. Phone: CHerry 3-3640.
Steve Sinkey (13), 160 North I St., Oxnard, Calif. (Theory)
Richard H. Johnson, 2299 Bluefield, Hayward, Calif.
John Lock (13), 836½ N. Hudson Ave., Hollywood 38, Calif. (Code and theory)
Tony Goodman (12), 10515 Camarillo St., No. Hollywood, Calif. (Code and theory)

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K9/W9 CALL AREA

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Allen Kostelnik (14), 4265 Delaware St., Gary, Ind. (Code and theory)

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To help prospective amateurs obtain their Novice licenses, the Radio-Electronics-Television Manufacturers Association offers a set of code records (recorded at a speed of 33⅓ rpm) and a Novice Theory Course for $10.00, postpaid. The complete course or more information on it is available from RETMA, 1721 DeSales St., N. W., Washington 6, D. C.

By B. VAN SUTPHIN

Oval-Flex Speaker Enclosure

Surprisingly good sound at an amazingly low price

YOU'VE ALWAYS WANTED an extra speaker for the bedroom, of course. But you've never been able to swing it, since you're practically flat busted. You nearly hocked the family jewels to acquire your living-room rig. So you sulk, and make do with that crotchety old table model that just manages to drag in some nearby AM stations.

Don't fret, brother. Build yourself an "Oval-Flex," at a total cost of maybe 11 or 12 bucks, and you'll be back in business.

How's that again? You say an oval speaker can't be used for high-fidelity sound? Well, that's what it says in the books. But after you've built one, you'll be in for the shock of your life. An oval speaker never sounded like this before.

There's a secret to it, though. You'll have to use a *coaxial* oval speaker.

The Speaker. Lafayette Radio has a a 6 x 9 dual coax unit for $7.95. Its twin tweeters cross over electro-acoustically at 5000 cycles. At the lower frequencies, most of the power enters the woofer's 3.2-ohm voice coil. As the frequency is increased, the inductance of this voice coil reaches a point at which its reactance exceeds the resistance of the series-connected voice coils of the tweeters (20 ohms). At that point, the power goes into the tweeters and you have the full coax at work.*

The problem of the enclosure is easily solved. I chose the bass reflex because it can return reasonable fidelity yet is simple to build. Actually, the cost of materials

* Note that this oval speaker is rated at 5 watts, and its total voice coil impedance is only 3.2 ohms. If it is placed in parallel with the average 16-ohm speaker running at high volume, its tweeter assembly may be damaged through overload. If it is used as a remote bedroom speaker, shunting the main speaker, it might be advisable to try a 5 to 10 ohm, 5-watt resistor in series with the speaker line. This resistor would serve the dual function of limiting the amount of power taken by the Oval-Flex and, in addition, giving it a slight boost at the bass end. If the Oval-Flex is used directly at the output of your amplifier with no other speakers in parallel, then no series resistor is necessary.

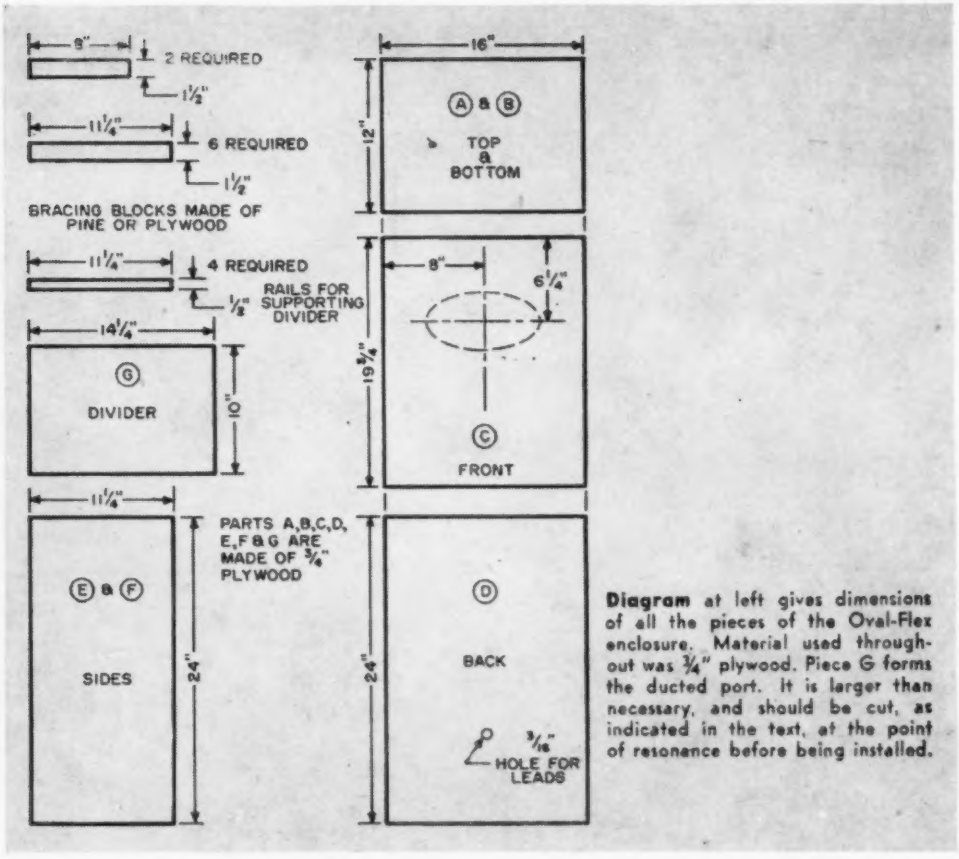

Diagram at left gives dimensions of all the pieces of the Oval-Flex enclosure. Material used throughout was ¾" plywood. Piece G forms the ducted port. It is larger than necessary, and should be cut, as indicated in the text, at the point of resonance before being installed.

was only about $4. I decided to use a ducted port for ease of construction. A tuned port would have required two front panels—one for the tuning experiments, the second for the final model.

The enclosure must be tuned to the speaker, i.e., the parallel resonant circuit of the enclosure must cancel the resonance of the speaker itself. When exact balance is obtained, the relatively sharp increase in speaker response at the resonant frequency is cut down and bass response is extended below the normal resonant frequency. This gives broad over-all response.

Building The Enclosure. Three-quarter-inch plywood was used throughout. There is just one gimmick in the building—you have to go according to the diagram. The ducted port length must be varied until the proper tuning point is reached. Then the excess is cut off and discarded.

Note inside view of enclosure before back was added (p. 112). There are blocks in the four corners for mechanical strength and braces along the sides of the front panel. Extra blocks are provided at the rear so that the back can be put on with wood screws. This permits a tight seal, yet allows the back to be removed when necessary. The rest of the enclosure can be put together with nails, but screws are recommended.

Although not shown, 12" squares of sound-absorbing material (Fiberglas) are glued to the sides, centered in the area between the sliding panel and the top. A 10" square is centered on the back two inches down from the top. The amount of Fiberglas used will determine somewhat the brightness of the sound.

Tuning. Turn the enclosure over when it's ready to be tuned. It's easier to work with, and there will be no obstruction in front of the port. Only a 1.5-volt flashlight battery is needed for tuning.

After installing the speaker, solder a 3' length of lamp cord or 300-ohm flat line to the voice coil terminals and insert it through the 3/16" hole in the back panel. Then close the back. Slide the panel all the way in, and touch the leads to the battery. You will hear a "thump." Slide the panel out slowly, touching leads at each new position until you hear more of a "click" than a "thump." You are approaching the proper point. Continue until you hear a

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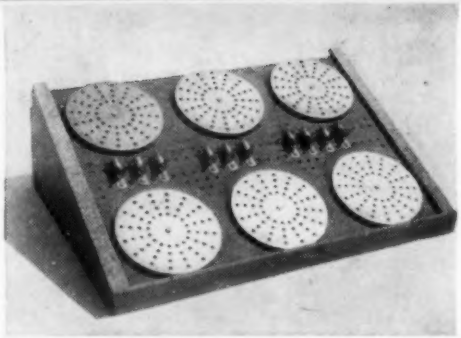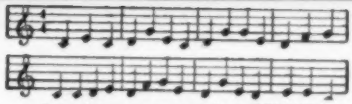

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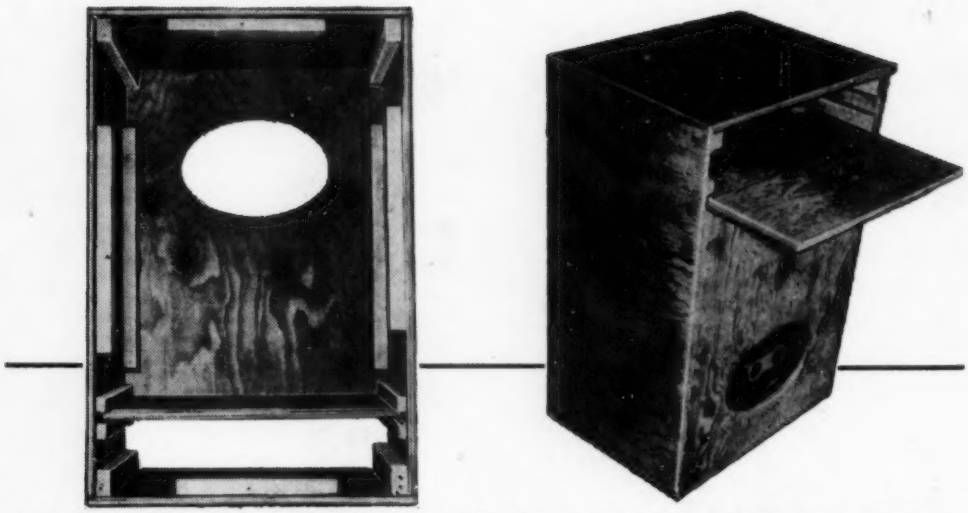


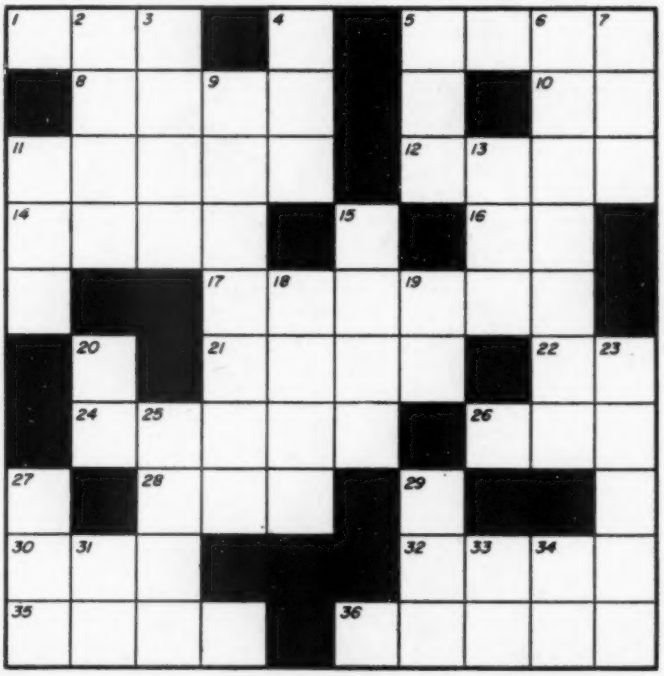
Rear view of enclosure before speaker is installed (above, left) shows position of bracing blocks. Note how ducted port is installed. The back should be put on with screws for tightest fit. Photo above, right, shows how to tune ducted port—it's best to turn the enclosure upside down.

sharp "click," then pass by until you get the "thump" again. Go back to the point which gave the sharp "click," and mark the sliding panel. Cut it off, replace it, and drive small nails in on each side, front and back, in order to hold it solidly in place.

Basically, that's the Oval-Flex. You can finish it in any way you desire. You may have heard better, but for the price, this will amaze you. —30—

CROSSWORD PUZZLE

By Arthur L. Branch



ACROSS

1 Automatic gain control: Abbr.
5 Plug-in type terminal.
8 Speed contest.
10 Hawaiian Islands: Abbr.
11 Type of switch.
12 Thin strip.
14 Legal trial or hearing.
16 Exists.
17 Positive electrodes.
21 Dielectric material.
22 Pronoun.
24 Electronic equipment not properly operating is said to be "on the ———."
26 Result of rapid combustion.
28 Playing card.
30 Type of tree.
32 Aid.
35 Parts of electronic tube envelopes.
36 Greek letter used as symbol for ohms.

DOWN

2 Color representing eight in color code.
3 Restaurant.
4 Prefix meaning over the whole extent.
5 James: Abbr.
6 Mounting part of electronic devices.
7 An asset to a "do-it-yourself" follower.
9 Type of capacitor.
11 Tape distortion.
13 Untruth.
15 To fasten.
18 Number represented by white in color code.
19 District attorney: Abbr.
20 Unit of relative power: Abbr.
23 Greek letter used as symbol for phase angle.
25 Device that changes electricity into heat and the heat into light.
27 Transformer winding: Abbr.
29 Male sheep.
31 Southern state: Abbr.
33 Exist.
34 Grid voltage: Abbr.

(See page 142 for solution)

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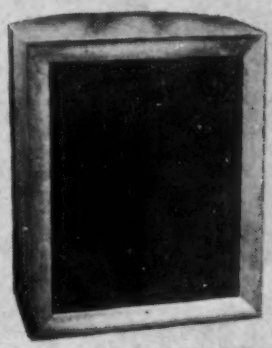
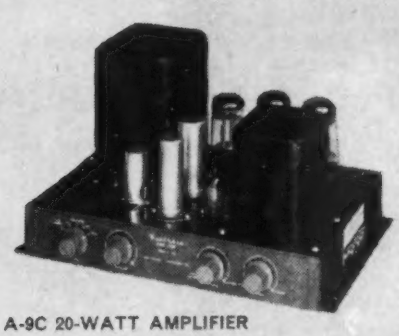


RANGE EXTENDER



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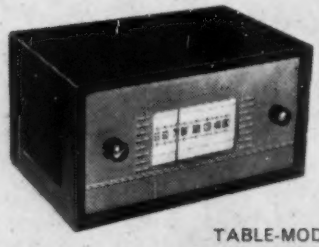
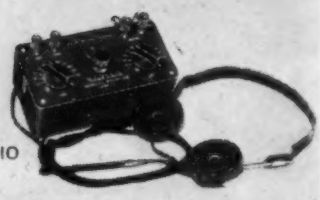
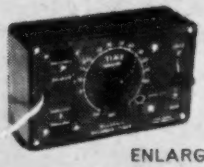


TABLE-MODEL RADIO



CRYSTAL RADIO



ENLARGER TIMER

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The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. Shpg. Wt. 4 lbs.

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$14.95

HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

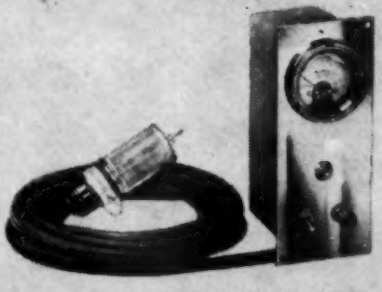
The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

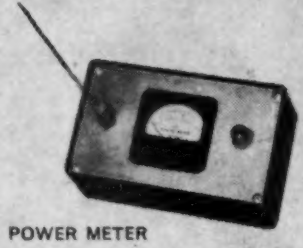
$49.95

(Available after November 15)

NEW! Heathkits for the boating enthusiast

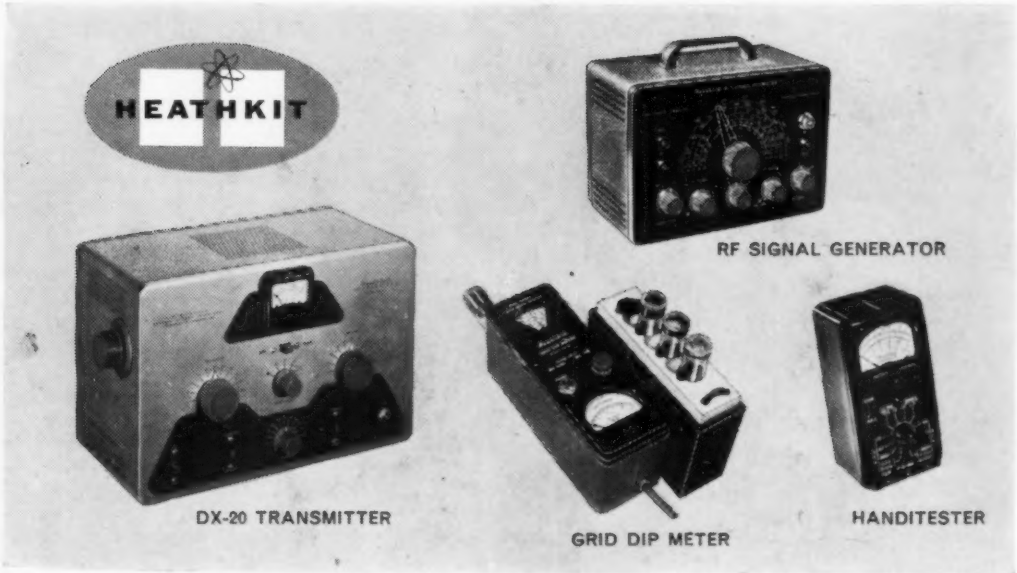


FUEL VAPOR DETECTOR



POWER METER

RADIO DIRECTION-FINDER



HEATHKIT DX-20 CW TRANSMITTER KIT

This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DQ6A tube in the 50-watt final amplifier circuit, a 6CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.

Model DX-20
Shpg. Wt. 18 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.

Model GD-1B
Shpg. Wt. 4 lbs. **$19.95**

HEATHKIT RF SIGNAL GENERATOR KIT

Produces rf signals from 160 kc to 110 mc on fundamentals on five bands, and covers 110 mc to 220 mc on calibrated harmonics. Output may be pure rf, rf modulated at 400 CPS, or audio at 400 CPS. Prealigned coils eliminate the need for calibration after completion.

Model SG-8
Shpg. Wt. 8 lbs. **$19.50**

HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0—10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

Model M-1
Shpg. Wt. 3 lbs. **$14.50**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0—1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0—4, 14, 40, 140, 400, 1400 and 4000 volts. X1, X10, X100, X10k, X100k, and X1 megohm.

Model V-7A
Shpg. Wt. 7 lbs. **$24.50**

HEATHKIT ALL-BAND RADIO KIT

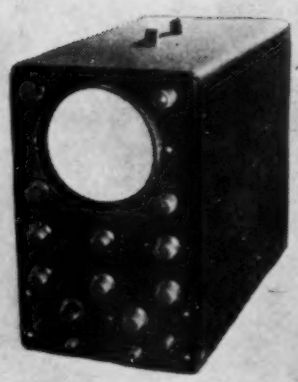
This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.

Model AR-3
Shpg. Wt. 12 lbs. **$29.95**
(less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

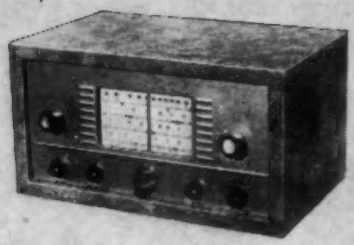
This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

Model OM-2
Shpg. Wt. 21 lbs. **$42.50**



"GENERAL-PURPOSE" SCOPE

VACUUM TUBE VOLTMETER



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Mechanical Brain

(*Continued from page* 53)

would be Frankenstein-type monsters who might refuse obedience.

Jogging the Curves. The human programmer who gave the milling machine its instructions took advantage of the mathematical fact that any curve on the blueprint can be approximated by a large series of intersecting straight lines, each of which is about 1/100th of an inch long. Each straight line is given three numbers —coordinates—to locate its position: up or down, sideways, and back or forth. This is necessary because the limited "mind" of the automatic milling machine "comprehends" only straight lines.

The programmer sits down at a teletype-like machine and carefully punches out a pattern of holes on a narrow paper tape, a pattern that corresponds to the three numbers assigned to each straight line.

Trigger Fingers. Inside the brain, a mechanical "reader" feels out the punched patterns like a blind man reading Braille and notifies certain relays to get ready for action. The reader is made up of needle-like metal fingers which press down on the tape as the latter passes over a metal drum. Whenever the metal fingers come over a hole in the tape, they contact the metal drum underneath and an electric circuit is completed. Each finger triggers one relay.

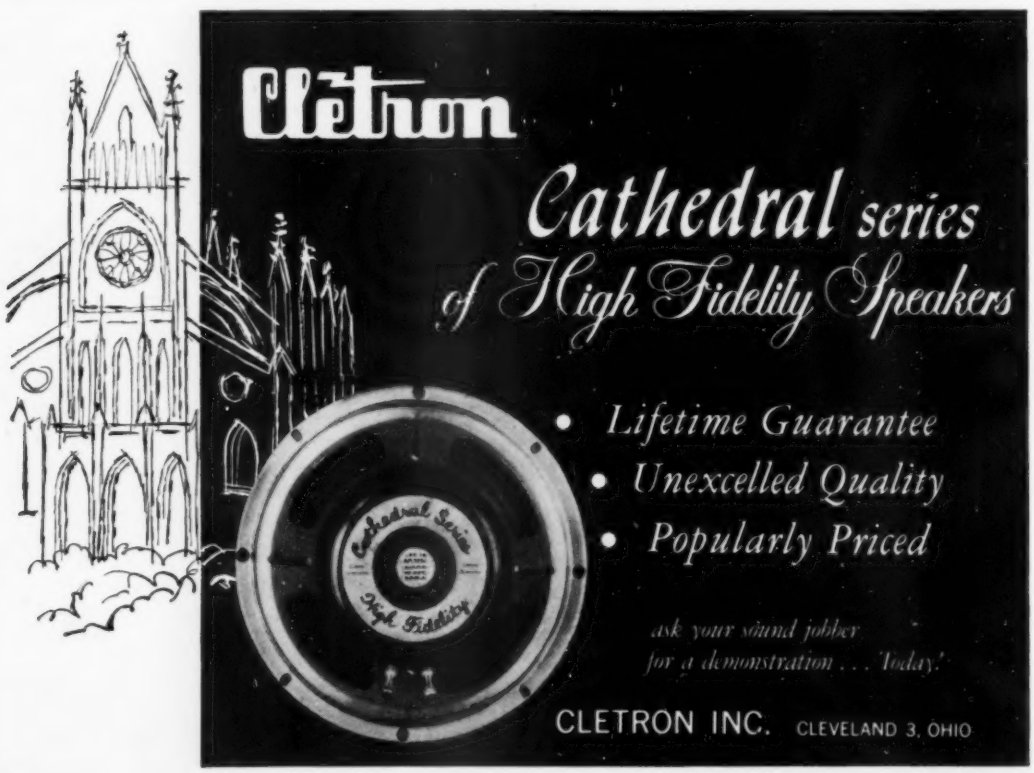
A group of punched holes—an order—thus sets up a certain preselected bank of relays which, in turn, govern servo-mechanisms or selsyn motors that control the motion of the machine tool.

The machine inspects its own work as it goes along. A feedback circuit sends back a description in electric terms of the work being done. This is compared to the original instruction contained on the tape. If the two don't check, the machine calls its own error and compensates for it.

Nobody has to pay any attention to the machine while it is working. After it finishes the workpiece, the machine stops. All the operator then has to do is put down his newspaper and slip a fresh blank into the machine.

Absentee Jobs. The beauty of numerical control is that once the "reader" in the mechanical brain has converted the punched tape into a pattern of electric signals, they can be transmitted by radio.

This entails such attractive possibilities as bodily sitting in one town while turning out a piece of work in another. Commuters and subway riders may jump at the idea,



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Here is the first and only kit of its kind—a heavy duty soldering and electrical kit by Ungar—a kit of a hundred uses. It contains the famous Ungar soldering handle (used by large electronics manufacturers everywhere) with interchangeable tips for every type of soldering and plastic welding. This iron will do everything you'd expect from a bulky 100-watt iron only better. Kit contains ten most useful items.

1. Famous Ungar Heavy Duty Handle, feather light, made to give years of service—simply thread in choice of tips. 110-120 AC-DC. **2.** Heavy Duty Screw-in Tip for all types of heavy duty soldering. Supplies a searing 825° F. tip temperature in 90 seconds. **3.** Precision Soldering Tip. Consists of heating element and ⅛"x 1" changeable tiplet for fine soldering—printed circuits, jewelry repair, plastic welding of model railroad cars, airplanes and boats. Tip temperature 600°F in 60 seconds. **4.** Trouble Light. Supplies steady, bright light into hard-to-get-at places. **5.** Circuit tester for tracing electrical troubles. Thread globe into handle and connect circuit tester to handle cord. Touch bare wires to terminals and if current is flowing the bulb lights. **6.** and **7.** Terminal Connectors, perfect for making permanent cord connections. Emery Paper for better soldering surfaces. **8.** Rosin Core Solder specified for electronics soldering—no flux required. **9.** Insulating Tape. **10.** Fully illustrated—easy to read 20-page "How to Do It" booklet.

Ungar Handle and Tips are U/L listed. Yes, all these useful items, beautifully packaged in this handy kit at only $4.95. This Ungar kit #507 is sold by electronics shops, hardware and hobby stores and Hi-Fi dealers.

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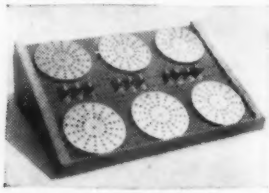

WHAT IS A GENIAC?

Here is a picture of the 1957 Model GENIAC in the display rack ($3.00 separately) which comes with every kit.

GENIAC stands for *Genius* Semi-Automatic Computer. A kit of specially designed switch decks and racks which permit the user to construct more than thirty different machines (following directions and wiring diagrams) and as many more as he is able to design himself. These machines demonstrate the applications of electric circuitry.

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PARTS—PANELS, DISCS RACK (for easy assembly and display). Hardware, wire, tools, battery, holder, etc. for more than thirty machines.

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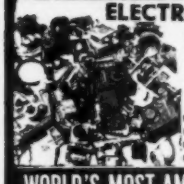

We stripped the finest Gov't Surplus to bring you this Value. Includes solenoids, transformers, potentiometers, capacitors, switches, plugs, coils, rheostats, plus so many others we can't list them all. . . .

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hoping to do a day's work at the plant from their back porch, but the military will probably have first crack at it.

If, for instance, a remote American base needs a critical machine part, the signals could be radioed to the base. The servomechanisms there would take over and the far-off milling machine would grind out the missing part pronto—right on the spot.

Since the invention of the steam railroad, technology has shrunk time and space in terms of transportation. Now the remote control of fast, automatic machines promises the conquest of time and space also in terms of work and productivity. —30—

I Hear You Talkin'

(*Continued from page* 65)

more convenient, a single 6-volt portable radio type "A" battery can be used.

Operation of the master unit can be achieved with any standard PM speaker as a remote. Standard three-wire intercom cable should be used for interconnection of the master and remote. The remote speaker will transmit *only* when its push-to-talk switch is depressed. This feature can be disabled by connecting a jumper wire between output terminals 1 and 2.

After installation, the gain control, which is mounted at the rear of the chassis, should be preset to a standard operating level and should not need readjustment until the batteries age.

This little job's independence of the a.c. power line makes it an ideal companion in areas where power is either not available or unreliable. —30—

HOW IT WORKS

Standard intercom techniques are used in the switching circuits. The "push-to-talk" d.p.d.t. spring-return rotary switch (*S2*) in the "master" interchanges the connections between the master's speaker and the speaker in the "remote" station.

Input transformer *T1* couples the speaker used as a microphone to the first stage by matching the low impedance of the speaker to the 1000-4000 ohm input impedance of the transistor, *R4* and *C2* serve as a decoupling filter and control *R3* serves as the collector load. By having resistor *R1* unbypassed, the input impedance of the stage is raised and enough degenerative feedback is introduced to insure stable operation.

Base bias for the second stage is supplied through *R5*. *R7* serves as the collector load. *R6*, like *R1*, is unbypassed and stabilizes *TR2*. The third (driver) stage uses the interstage coupling transformer, *T2*, to match the output impedance of the driver to the lower input impedance of the power output stage. The 2N255 transistor (*TR4*) is the power output stage; base bias is supplied through *R10*. Output transformer *T3* couples the output of the 2N255 to the loudspeaker voice coil.

A s.p.s.t. toggle switch, *S1*, is the power on-off switch. *C6* functions as a bypass capacitor to prevent feedback through the common battery power supply.

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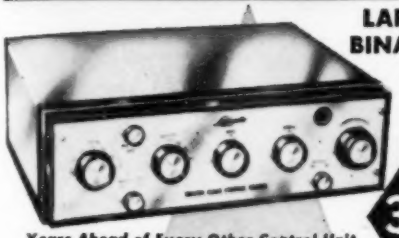

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Years Ahead of Every Other Control Unit
Ahead In Design . . . Ahead In Sound
Ahead In Features . . . Ahead In Styling.
• **Available In Kit and Wired Form.**

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾" x 9⅛" x 3¾". Shpg. wt., 10½ lbs.

KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. ..... Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. ..... Net **59.50**

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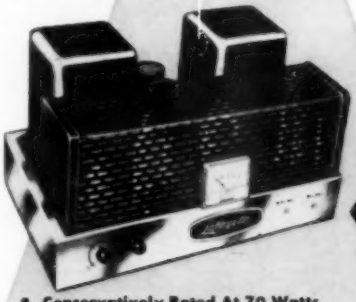

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- **Available In Kit And Wired Form**

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LT-60 **49.95** WIRED FM TUNER

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- **9 Tubes Plus Selenium Rectifier**
- **Custom Styled**

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- ACCOMMODATES ALL POPULAR CARTRIDGES

All the important features of professional transcription players have been incorporated in this precision turntable. Extremely smooth and quiet heavy duty 4-pole motor plays 78, 45 and 33-1/3 RPM records. Exclusive magnetic brake, controlled by knob on base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included checks speeds. Speed selector safety switch protects mechanism by making it necessary to pass through OFF position when switching from one speed to another. 10" weighted turntable has rubber traction mat.

Mounting plate has pickup rest and ON-OFF switch. Size: 12-15/16" left to right. 10⅞" front to rear. Requires 2¾" clearance below motor board and 3" above. With AC line cord, 2 plug-in heads, output cable, 45 rpm adapter. For 105-120V., 60 cycles AC. Shpg. wt., 12 lbs. *(NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)*

PK-160—Less cartridge and base ..... Net **25.95**

PK-162—Wood base for PK-160. Shpg. wt., 5 lbs. ..... Net **3.95**

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Lafayette presents this outstanding 3-way speaker system designed for the high fidelity enthusiast who desires performance formerly possible in multi-speaker systems costing many times this price. You won't believe your ears when you hear the superb reproduction throughout the entire audio spectrum. The SK-67 15" woofer provides phenomenal bass response, the SK-74 8" speaker delivers full bodied, mid-range frequencies, and the HW--7 high frequency acoustical lens tweeter faithfully reproduces the highest audible frequencies. Crossover points at 350 and 5000 cycles are provided by the LN-3 3-way inductance-capacitance network with continuously variable presence and brilliance controls that adjust tone balance to personal taste. Shpg. wt., 25 lbs.

SY-93. Complete System as listed above ..... Net **55.50**

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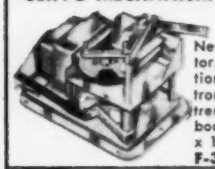
- CROSSOVER NETWORK
- IMPORTED HI-FI TWEETER
- LEVEL-BRILLIANCE CONTROL

This 2-way speaker system is another excellent buy for the moderate purse. It is basically the same as the SY-85 system described at the top of the page, but incorporates the deluxe SK-68 speaker with 21.5 oz. Alnico V magnet. This results in more efficient reproduction and extension of the lower register. Complete system includes the SK-68 12" 25 watt woofer, HK-3 cone type tweeter and LN-2 crossover network with level-brilliance control. Range of system 35-16,000 cycles. Shpg. wt., 18 lbs.

SY-87—Complete System ..... Net **27.50**

Lafayette's Radio-Control Specialties

R/C ELECTRIC SERVO MECHANISM



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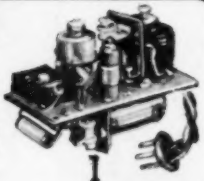
New, powerful, motor driven R/C actuator. Delivers positive, instantaneous action. Provides selective steering and electronic, automatic return to neutral. Extremely efficient when used with model boats and land vehicles. Only 2½" x 2" x 1¾". Includes instructions and linkage.

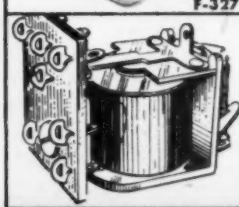
F-327 ..... Net **5.95**

LAFAYETTE SPECIAL R/C RECEIVER



Completely wired and assembled, with tube, ready to operate on exam free 27.255 MC remote control band. Size: 1⅜" x 1-15/16" x 3". Weight 3.3 oz. Uses one 1.5 volt and one 45 volt battery. Less batteries. Shpg. wt., 6 oz.

F-208 ..... Net **8.95**



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The Mighty Mite of the R/C field. Weighs less than ½ oz.! Only ¾"H x 17/32"W x 1-1/16"L. Highly sensitive—extremely rugged. Pulls at 1.4 Ma—drops out 1.2 Ma D.C. S.P.D.T. 5000 ohm coil.

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Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. This kit represents the optimum in sensitivity, selectivity and stability. You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit uses 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode and features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2¾" speaker, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 6" x 3⅛" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case.....Net **33.50**
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119 Shpg. wt., 1 lb.....Net **2.95**
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3 TRANSISTOR SUPERHET POCKET RADIO KIT

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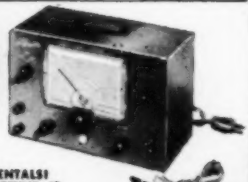

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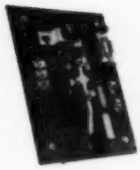
LSG-10 — Signal Generator **22.50**



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For those interested in mastering the international code, an audio tone oscillator is essential. The circuit of this transistorized feedback oscillator has the simplicity of the neon glow, the signal strength of the vacuum tube, and requires only two penlite cells for weeks of service. It may be used for solo practice, or two may send and receive with the same unit. Kit comes complete with Transistor, Telegraph Key, Resistors, Condensers, Masonite Board, etc., and Schematic Diagram.

KT-72 ..... Net **2.99**
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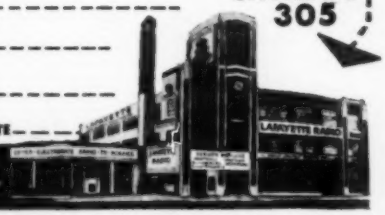

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General Electric 5BA10AJ370 Gear reduction 250 RPM..... $4.95

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This substance is now available in *suppository or ointment form* under the name *Preparation H.** Ask for it at all drug counters—money back guarantee.

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Hi-Fi Fall Roundup

(*Continued from page* 102)

belts and friction rollers—components which wear rapidly and often cause recorders to develop wow and flutter.

The Rise of Stereo. Stereo sound appears slated for an enlarged role in the over-all hi-fi picture. At least, so it seems from the increasing number and variety of available stereo equipment. For instance, LAFAYETTE RADIO offers a new FM-AM stereo tuner to be used in localities where stereo broadcasts can be received. It comes either as a kit or fully assembled. Lafayette's new Audio Control Center kit also offers binaural facilities with a dual volume control to adjust proper balance between the two channels. Of course, the unit can also be used to provide complete control facilities for conventional single-channel audio.

Another line of stereo components in kit form is offered by TELEMATIC INDUSTRIES. Their tuner has a pre-wired FM front end and their stereo amplifier delivers 40 watts.

The ARKAY company also has come out with a complete kit line of stereo components, consisting of tuner, preamplifier and power amplifier.

All these kit components sell at low price, and even when they are ordered ready-wired, they are still a bargain.

Unusual Accessories. Accessory components offered by VIDAIRE are "outboard" units to be connected *between* the customary components. One is a "Bass & Treble Equalizer," a passive network to be connected between amplifier and speaker. The insertion of such a device into the speaker line may incur loss of damping, but in

WANT TO KNOW MORE?

For full specifications on any of these new high-fidelity products, write to their manufacturers.

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Brooklyn 21, N. Y.

Arkay Kits Inc.
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New York, N. Y.

Vidaire Electronics Mfg. Corp.
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Lynbrook, N. Y.

Grado
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MusiCraft
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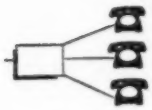
Pacemakers in the technology of our electronic age

Certain discoveries, inventions and developments of Bell Telephone Laboratories have been truly epochal in their effect upon the technology of our time. Each has come out of a single quest —a search for ways to make telephony ever better. But many have opened the way to exciting advances in TV, movies, radio, horology, astronomy. Here are ten of Bell Laboratories' contributions to the modern world.

Electronic amplifier. First high-vacuum electronic amplifier. Made possible long distance telephony and then opened the way to radio broadcasting.



Wave filter. Precisely separates bands of frequencies. Provided major key to economical sharing of the same wires by many voices or radio programs. Indispensable control tool in radio, television and radar.

Negative feedback amplifier. Provides distortionless and stable amplification. Made possible the enormous, precisely controlled amplification needed in long distance telephone calls. The principle is now basic in amplifiers for radio, TV and high-fidelity reproduction.

Quartz crystal. Standard super-accurate quartz crystal oscillator developed for frequency controls in radiotelephony. Has also become the standard control for clocks in world's astronomical laboratories.

Coaxial cable system. Hollow tube with a central conductor was developed to transmit hundreds of voices simultaneously. Now also provides long distance carrier for TV in partnership with microwave beams.

Transistor. Tiny solid-state device uses extremely small amounts of power to amplify signals. Makes possible electronic telephone switching and much smaller hearing aids, radios, TV sets and electronic computers.

Dial system "brain and memory." Takes over your call and sees that you are connected in the best and quickest way. Newest example: Direct Distance Dialing from home telephones to any part of the nation.

Waveguide. Hollow conductor transmits high-frequency waves. From this came "pipe" circuits essential to radar and very short-wave radio communications.

Microwaves. Bell Laboratories developed long distance microwave transmission. It operates by focusing radio beams from station to station, carries cross-country telephony and TV.

Radio astronomy. This great new science began in the study of radio interference at Bell Laboratories . . with the tremendous discovery that radio waves emanate from the stars.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

setups lacking other tone control facilities, this offers an inexpensive substitute.

Other items in the Vidaire line include a high-pass filter consisting of a 4-μfd. capacitor in series with a potentiometer. This blocks bass from the tweeter, but since it doesn't keep highs from the woofer, it seems incorrect to call it a crossover network. However, it is the cheapest way to obtain the necessary frequency division and a tweeter level control for a two-way system.

Vidaire also has a volume expander which, when connected into the speaker line, tends to emphasize the dynamic range of music (making loud louder and soft softer) but again at the cost of impaired damping.

Among cartridges, a new top-quality model by GRADO is claimed to be flat from 18 to 28,000 cps, carries a shot of uranium sulfate to eliminate record static and sells for $45. A new entry among tone arms is an improved version of Lafayette's viscous damped model, which carries its supply of damping fluid in a sealed compartment. This model is called the PK-150.

It is hoped that after the Audio Fair we will be able to scan a wider range of new developments and report in more detail on the new design principles employed in some of them. —30—

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Model 10

Here is a real value—much more value than in any other clamp-on ammeter. Remember, in Triplett Model 100 you get not only a clamp-on ammeter but a genuine Triplett complete Volt-Ohm-Milliammeter with which you can measure AC volts, DC volts, AC and DC current, and Ohms.

triple news from triplett

1st news: Triplett Model 10 Clamp-On Adapter

Just plug into any Triplett Model 310 Miniature VOM it becomes an AC clamp-on ammeter to measure AC amperes without cutting or opening current carrying wires. The split transformer yoke opens at the touch of a lever to fit around a single conductor or bus-bar for direct readings of AC amperes from 6 to 300 in 6 steps. Model 10 $14.50 net.

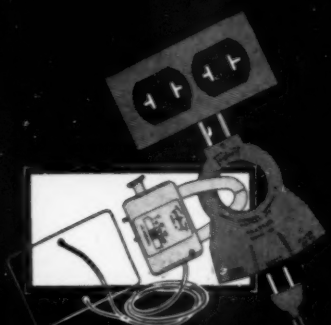
The Model 10 can be separated from the Model 310 as shown in the drawing at left by No. 311 lead attachment. This permits readings in difficult locations. No. 311 leads $1.90 net.

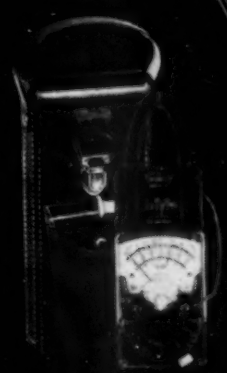
2nd news: Triplett Model 101 Line Separator

Serves to plug in at outlet to divide 2 conductor cords for clamp-on measuring. Makes accurate, rapid-testing of radio and TV sets, phonographs, appliances, motors, etc. possible without opening or splitting double conductors. Also serves to increase ammeter sensitivity 10X and 20X, if desirable, for easier reading. Model 101 $5.50 net.

3rd news: All four parts are available conveniently packaged in one handy, durable, high-quality carrying case. This complete package is known as Triplett Model 100 and is priced at $61.90 net.

Model 100 consists of Model 310 VOM, Model 10 Clamp-On Adapter, Model 101 Line Separator, No. 311 leads and carrying case with provision for all parts.





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In addition, to use with the Model 310, the Model 10 Adapter also can be used as a Clamp-On Ammeter with any Volt-Ohm-Milliammeter having a 3 AC volt scale at 5000 Ohms per volt such as Triplett Models 630, 630-A, 630-NA, 631, etc., by employing Triplett No. 611 leads, $1.90 net.

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Transistor Topics

(*Continued from page* 97)

ticles in Spacistors and transistors work may be made by dropping a single ink drop into two glasses—one empty, the other filled with water. The drop reaches the bottom of the empty glass almost instantly, similar to the rapid action of electrons in the Spacistor. In the filled glass, the drop slowly diffuses until it finally reaches the bottom—similar to the relatively slow diffusion of charged particles through the junction of a transistor.

Reader's Circuit. Regenerative detectors are probably the most popular—and the most sensitive—of simple transistor receiver circuits. The majority of these circuits use a special "feedback" coil to provide regenerative feedback . . . but not the circuit shown in Fig. 2, which was submitted by POP'tronics reader Lawrence R. Weill, 6911 East Seaside Walk, Long Beach 3, Calif. Instead, Larry's circuit depends upon feedback within the transistor itself.

Basically, the receiver is a tuned-base, tuned-collector oscillator, with the tuned circuits coupled through the transistor's interelectrode impedances. Oscillation is prevented (or permitted) by adjusting the value of the base coupling capacitor *C2*. Loop antenna *L1* and tuning capacitor *C1a* form the base tuned circuit, while coil *L2* and capacitor *C1b* make up the collector tuned circuit. The amplified output signal is obtained from secondary winding *L3* and detected by a separate crystal diode, *CR1,* then coupled through *C3* to an external a.f. amplifier. Power is supplied by a three-volt battery, *B1,* which may be made up by connecting two penlite cells in series.

Since there are *two* tuned circuits, this receiver has improved selectivity as well as good sensitivity. Larry picked up some 20 local stations (within 150 miles) with good headphone volume and sharp selectivity on the first day he tried his circuit—*using only the built-in loop antenna.* He employed a two-stage transformer-coupled transistorized audio amplifier following the detector and a pair of 4000-ohm headphones.

Construction is simple and straightforward. *L1* is a standard broadcast-band loop antenna, *L2* a Vari-Loopstick upon which 40 turns of #30 enameled wire (*L3*) have been tight-wound. *C1a-C1b* is a standard two-gang, 365-$\mu\mu$fd. tuning capacitor with trimmers. Control *C2* is a 140-$\mu\mu$fd. variable capacitor. *CR1* may be any standard diode, e.g., a 1N58 or 1N34A.

(*Continued on page* 134)

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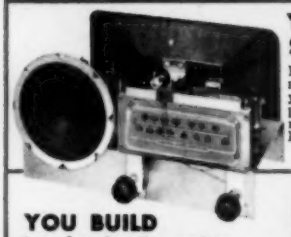
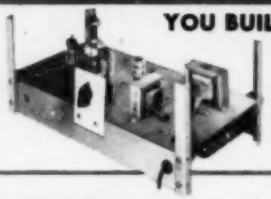


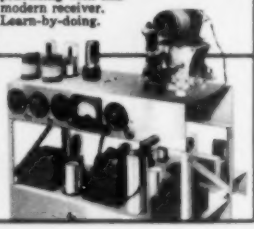
YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



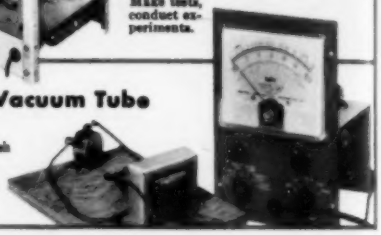
YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.



YOU BUILD Broadcasting Transmitter

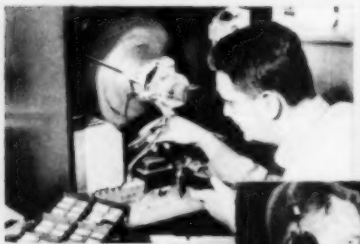
As part of NRI Communications Course you build this low power Transmitter; learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.



YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs
Be a Television-Radio Technician



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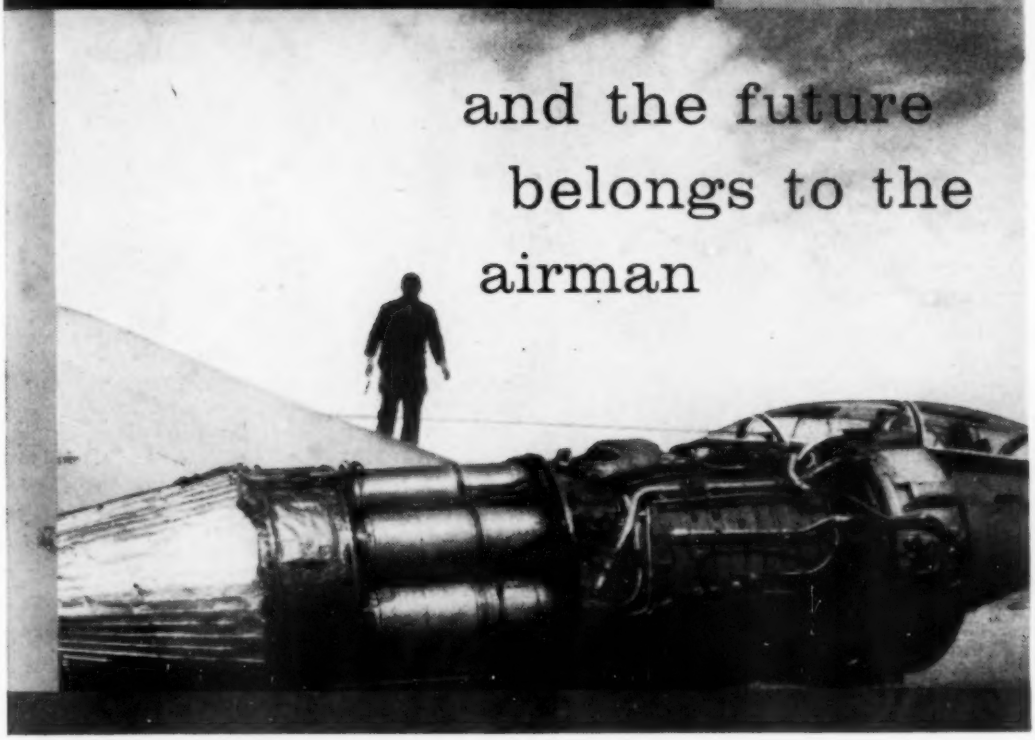

You have read about the early Age of Flight...grown up in the Jet Air Age. Now, as a young man, you stand on the threshold of a new age in which man will conquer outer space. It will be the age of trained technicians—those who have backgrounds in rocketry, jet propulsion, electronics, mechanics and allied fields. And nowhere else is such training so available or so complete today as in the U.S. Air Force. Consider this fact as you plan your future. By joining the Air Force, you will, of course, meet your military obligation. But much more important, you will prepare yourself for unlimited opportunities in the new Age of Space. See your local Air Force Recruiter today—or mail the coupon.

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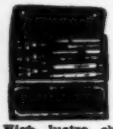

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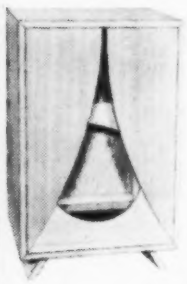
A BOX IS NOT A MUSICAL INSTRUMENT!



No skilled musical instrument maker, including even those in aboriginal tribes, has ever found a rectangular box satisfactory. **IN SPITE OF THIS,** today many HI-FI speaker systems proclaim the ultimate in high fidelity, yet they employ nothing more than the most elementary boxes to perform the complicated function of transforming the vibrations of the loudspeaker into sound.

In the **KARLSON ENCLOSURES,** specially curved internal and external structures are used to provide you with the highest performance capabilities available in the industry today. Actually the Karlson Enclosure is one of the most fabulous musical instruments ever created and is capable of reproducing every sound from a baby's breath to the mighty roar of thunder. After long and rigorous tests, we know definitely that the Karlson Enclosures can outperform all other units now available on the market at any price.

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Transistor Topics

(*Continued from page* 130)

When wiring the circuit, check to make sure that *C2*'s plates *do not short* at any point; if they do, insert a 0.001-$\mu\mu$fd. capacitor in series with this component. Make sure that *L1* and *L2* are *not* coupled inductively—you can probably do this by mounting them so that their axes are at right angles and there is reasonable separation between them. Be sure to observe battery polarity—the 2N170 is a *n-p-n* r.f. transistor.

To "align" the receiver for peak performance, connect its output terminals to any standard audio amplifier having either earphone or loudspeaker output. Fully mesh the tuning capacitor's plates (*C1a-C1b*). Now turn the regeneration control (*C2*) to a point *just prior* to oscillation. Adjust *L2*'s slug until oscillation occurs. Then reduce *C2*'s capacity until regeneration stops. Readjust *L2*. Continue this adjustment until turning *L2*'s slug does not result in regeneration.

Next, fully open the tuning capacitor and adjust *C1b*'s trimmer until it is half closed. Adjust *C2* to a point just prior to oscillation, as before. Now repeat the steps of the first adjustment, but this time adjusting *C1a*'s trimmer capacitor instead of coil *L2*.

If you have difficulty obtaining oscillation (regeneration), check your wiring and parts. If you suspect that coupling exists between *L1* and *L2*, try reversing the connections to *one* of the coils. The inductance of *L1* and *L2* should be approximately the same and too great a discrepancy may cause trouble. Try adding or removing turns from *L1* if you think there might be a radical mismatch. As a last resort, you can try a new transistor.

D.C. Power Supplies. Most of you probably spend considerable time bench-checking transistorized equipment and experimental transistor circuits. Batteries

Electro's Model D-612T filtered d.c. power supply.

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APOLOGY TO OUR READERS—Due to the tremendous response to our wonderful tube values, our huge staff was unable to adhere to our Same Day Shipment policy. We wish to offer our profound apologies for any inconvenience caused our customers. We are attempting to remedy the situation at once. DON'T PAY MORE FOR SET TESTED LONG LIFE DEPENDABLE HI-FI RADIO AND TV TUBES • BUY VIDEO • INDIVIDUALLY BOXED—ALL GUARANTEED FOR ONE YEAR OR YOUR MONEY BACK WITHIN 5 DAYS.

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Soon after starting you will be able to earn extra cash fixing toasters, clocks, fans, vacuum cleaners, etc., for neighbors and friends. Keep your job while learning and earning. Put spare time to work for you. Work in your basement, garage, spare room. You'll be amazed how easily, quickly you, too, can start earning many extra dollars. NRI shows you how. Even before you finish training your spare time earnings may pay for the course and equipment.

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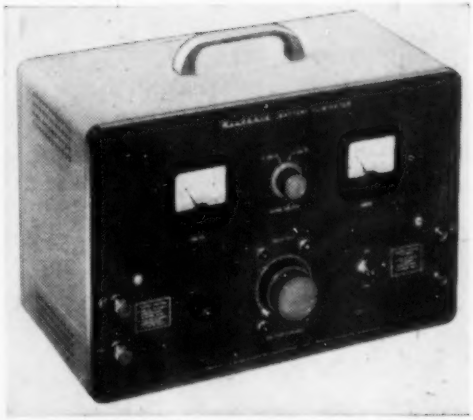


Heath's BE-5 battery eliminator, available as kit.

are not entirely satisfactory for this work as various voltages are required for different circuits and high current equipment (using power transistors) may exhaust standard sized batteries quickly. Nor are standard heavy-duty "battery eliminators" suitable; while useful for low-current circuits, their usually poorly filtered output introduces heavy hum in equipment requiring moderately high currents.

Fortunately, several manufacturers are in the process of introducing d.c. power supplies with built-in filter circuits designed especially for working with transistor circuits and servicing transistorized receivers. Such units can be used equally well on small-current, single-stage circuits or to supply currents of several amperes to auto receivers or p.a. amplifiers. Your columnist was recently given the opportunity to check out a few of these instruments.

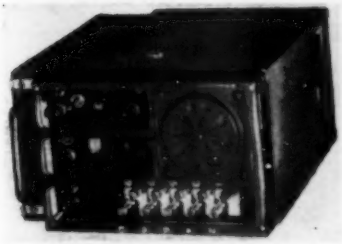
The Model D-612T filtered d.c. power supply, manufactured by Electro Products Laboratories, 4501 North Ravenswood Ave., Chicago 40, Ill., is typical of the "factory-built" units now being offered. It supplies filtered d.c. output currents of up to 10 amperes in two ranges, 0-8 and 0-16 volts. At currents up to 5 amperes, ripple is less than 0.5%; at low current loads, it is well under 0.1%. Up to 21 volts can be obtained for servicing low-current portable transistor radios. The output voltage is continuously variable on each range, with both voltage and current monitored by panel meters, and the unit will stand intermittent overloads up to 100%. Model D-612T *nets* for about $45.00 and is sold through leading local and mail order parts distributors.

Typical of the "kit" instruments is Heath's new BE-5 battery eliminator (The Heath Company, 305 Territorial Rd., Benton Harbor, Mich.). It supplies filtered

"LOOKEE!! ALL THREE UNITS $29.95

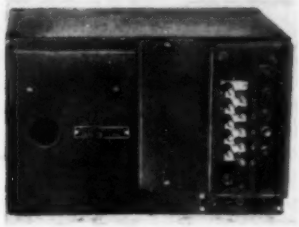
RECEIVERS, TRANSMITTERS, POWER SUPPLY

GOVERNMENT COST $1234.00"



BC-603 RECEIVER—$17.50 ea.

10-Tube 20-27.9 Mc. Superhet. circuit. F3 reception. Variable or pushbutton tuned on 10 pre-selected channels. Operates on 12 V. DC with dynamotor supplied. Complete with tubes. Ship. wgt. approx. 50 lbs. ea. Size 12⅛" x 11½" x 6¾". Excellent condition. Price separately .....**$17.50 ea.**

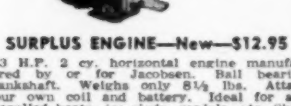


BC-604 TRANSMITTER—$9.95 ea.

30 watt crystal controlled on 10 preselected channels in range of 20-27.9 Mc. F3 emission. Operates from 12 or 24 V. DC (dynamotor not supplied). Tubes and meter supplied worth price of entire unit. Size 18" x 10" x 12". Excellent to new condition. Ship. wgt. approx. 100 lbs. ea. Price separately .....**$9.95 ea.**

6-12-24 V. VIBRATOR POWER SUPPLY —$9.95

PE-237 Non-synchronous vibrator type. Input: 6 V. 36 amp., 12 V. 17 amp., or 24 V. 9.5 amp. DC. Output: 525 V. DC .095 amp., 1105 V. DC 4.2 Ma., 6½ V. DC 2 amp., 6 V. DC ⅛ amp., 1.35 V. DC 450 Ma. Higher current drain may be obtained with no ill effect. This power supply can be used successfully for powering the BC-604 transmitter. Steel brown crackle. Size 20¼" x 11" x 10". Ship. wgt. 119 lbs. ea. Excellent to new condition. Price separately **$9.95**



SURPLUS ENGINE—New—$12.95

2.3 H.P. 2 cy. horizontal engine manufactured by or for Jacobsen. Ball bearing crankshaft. Weighs only 8½ lbs. Attach your own coil and battery. Ideal for air-propelled boats, ice sleds, models, etc. Ship. wgt. 12 lbs. Engine only .....**$12.95** Propeller and hub. Ship. wgt. 4 lbs..**$15.00**

TS-9 HANDSET—$2.95

Ideal for your mobile rig. Contains 250 ohm rec. element and single button carbon mike transmitter unit. Will replace your T-17 or other single button mike. Excellent to new condition. Ship. wgt. 5 lbs. Price.....**$2.95 ea.**

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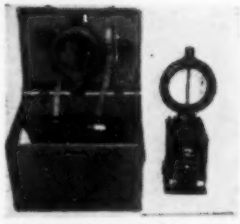
TU-25-A TUNING UNIT—New—$1.95

Transmitter type in range of 3500-5250 Kc. originally used on BC-223 transmitter but makes ideal foundation for your home constructed transmitter. Shipped in heavy 3/32" steel case with piano hinge cover. Case alone worth price. Complete, new...**$1.95 ea.**



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Convert your present receiver for loop reception for direction finding. Freq. range 2.3—10 mcs. Ideal for mobile or marine use. Has self-contained 12 V. DC vibrator power supply. Connection is simple by merely connecting 12 V. DC source and antenna output to receiver antenna input. Has sensing and phasing switch and multicolor vernier illuminated dial. Increased sensitivity will be found over most usual antenna systems. Size of unit 7" x 24" x 9" mounted on shock base. Shipped in wood and metal carrying case with spare tubes, vibrators, etc. All necessary lead wires incl. Orig. price $315.00. Shipping wgt. 60 lbs.

BRAND NEW—SURPLUS BARGAIN $12.95

RECEIVER R-1/ARR-1—$1.95

Range 234-258 Mc. For conversion to various preselectors, converters, etc. Shipped with tubes in aluminum case 10" x 3½" x 3". Complete with conversion article as in January 1949 Radio-TV News. New demilitarized units (input coil insulation broken, easily repaired). Ship. wgt. 4 lbs. Price.....**$1.95 ea.**

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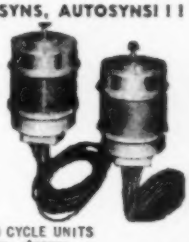

Navy Size & Type	110 V. 60 CYCLE UNITS Approx. Weight (lbs.)	Approx. Length (inches)	Approx. Diameter (inches)	Price Used	Price Rebuilt
5F	5	6.0-6.8	3.4-3.6	$5.00	**10.00**
5G	5	6.0-6.8	3.4-3.6	5.00	**10.00**
5DG	5	6.0-6.8	3.4-3.6	5.00	**10.00**
5CT	5	6.0-6.8	3.4-3.6	5.00	**10.00**
6G	8	6.4-7.5	4.5	7.50	**15.00**
7G	18	8.9-9.2	5.8	10.00	none
7DG	18	8.9-9.2	5.8	10.00	**15.00**

Size & Type	110 V. 400 CYCLE UNITS Approx. Weight (lbs.)	Approx. Length (inches)	Approx. Diameter (inches)	Price New (Cases may be slightly nicked)
5F	5	6.0-6.8	3.4-3.6	**3.50**
5G	5	6.0-6.8	3.4-3.6	**3.50**
5DG	5	6.0-6.8	3.4-3.6	**3.50**

CT—Control Transformer; D—Differential Motor; DG—Differential Generator; F—Motor (Follower); G—Generator. Mfgd. by Bendix, Ford Instrument Co. and General Electric. Specify, Bendix, Ford & GE in stock.

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d.c. output currents of up to 5 amperes continuous service or up to 7.5 amperes intermittently in two ranges, 0-6 and 0-12 volts. In either range, the output voltage is continuously variable, and ripple is *less than* 0.3% at currents up to 5 amperes. In addition to the filtered output, the BE-5 has a separate pair of output terminals providing an *unfiltered* output; here continuous currents of up to 10 amperes may be drawn on the 6-volt range, up to 5 amperes on the 12-volt range. On intermittent duty, the instrument will supply currents up to 50% higher than its continuous-duty ratings. Assembling easily in one or two evenings, or on a week-end, the BE-5 is available by mail order only and sells for $39.95 plus shipping costs ($2.00 to $4.00 to most areas).

Product News. Eby Sales Company (130 Lafayette St., New York 13, N. Y.) has announced a low-cost transistor tester. Called a "TRANS-TESTER," the instrument nets for $4.95. It is designed for use with a standard VOM.

One of two new transistors announced by RCA (Semiconductor Div., Somerville, N. J.), the 2N384 is a high-frequency *p-n-p* type. Although a triode unit, it may be used as an oscillator at frequencies up to 250 *megacycles,* as an amplifier up to 100 mc. The unit provides a gain of 15 db at 50 mc., 30 db at 10.7 mc. Maximum collector voltage and current is 30 volts and 10 ma. Dissipation (at 25° C) is 120 mw.

The other new RCA transistor is the 2N398. A *p-n-p* unit, the 2N398 is intended for relatively high voltage applications, such as circuit switching, neon lamp indicator control, relay puller circuits, and so on. The maximum collector voltage and current are 105 volts and 100 ma., respectively. Dissipation (at 25° C) is 50 mw. (maximum).

That's it for now, fellows. See you next month. . . .

Lou

"Economy" Multitester

(*Continued from page* 74)

Adjust the 500K pot to 45 volts, and the neon tester control until the neon just glows. Then mark this new point on the scale. Continue until the scale is completely calibrated with as many points as desired. This one procedure calibrates both the a.c. voltage scale and the d.c. voltage scale.

Ohms calibration is best accomplished

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0Z4	.42	5AM8	.79	6BE6	.45	6U8	.54	12J5	.39
1A7GT	.42	5AN8	.79	6BF5	.39	6U8	.59	12L6	.59
1B3GT	.66	5A95	.49	6BG6G	1.17	6V3	.79	12SA7	.47
1C5GT	.40	5AT8	.79	6BH6	.50	6V6GT	.45	12SG7	.54
1C6	.25	5J6	.59	6BJ6	.46	6W4GT	.39	12SJ7	.44
1C7G	.25	5T8	.79	6BK5	.67	6W6GT	.52	12SK7	.47
1D5GP	.42	5U4G	.48	6BK7	.75	6X4	.39	12SL7GT	.59
1H4G	.45	5U8	.79	6BL7GT	.74	6X5	.38	12SN7GT	.56
1J6GT	.46	5V4G	.57	6BN6	.57	6X8	.74	12SQ7	.39
1L4	.45	5V6GT	.49	6BQ6GT	.79	7A4	.46	12V6GT	.44
1L6	.64	5X8	.79	6BQ7	.75	7A5	.52	12W6	.59
1LA4	.55	5Y3	.38	6BY5G	.57	7A6	.44	12X4	.36
1LA6	.46	5Y4G	.42	6BZ7	.75	7A7	.44	14A7	.44
1LB4	.58	5Z3	.44	6C4	.36	7A8	.44	14B6	.44
1LC5	.48	6A7	.56	6CB6	.50	7AU7	.69	14Q7	.44
1LC6	.46	6A8	.46	6CD6G	1.17	7B4	.43	19T8	.69
1LD5	.56	6AB4	.44	6CU6	.79	7B5	.40	19BG6G	1.17
1LE3	.56	6AC7	.66	6D6	.47	7B6	.41	25R06GT	.84
1LH4	.63	6AF4	.75	6E5	.43	7B7	.42	25CA5	.79
1L[illegible]	.46	6AG5	.49	6F5	.36	7B8	.46	25CD6	1.29
1N[illegible]	.49	6AG7	.68	6F6	.37	7C4	.40	25CU6	.99
1R5	.50	6AH4GT	.69	6H6	.37	7C5	.41	26L6GT	.46
1S5	.45	6AH6	.70	6J4	1.59	7C6	.42	25W4GT	.42
1T4	.50	6AK5	.53	6J5	.38	7C7	.44	25Z6	.36
1U4	.46	6AL5	.41	6J6	.48	7E5	.44	27	.24
1U5	.45	6AM8	.79	6K6GT	.38	7E6	.44	35B5	.47
1V2	.70	6AN8	.79	6K7	.38	7E7	.48	35C5	.47
1X2	.66	6AQ5	.45	6L6	.67	7F7	.58	35L6GT	.46
2A3	.49	6AS5	.47	6N7	.59	7F8	.65	35W4	.38
2A7	.54	6AS7G	2.25	6Q7	.39	7G7	.74	35Y4	.38
2D21	.95	6AT6	.79	6S4	.39	7N7	.57	35Z3	.40
3A4	.50	6AT8	.79	6S8GT	.70	7Q7	.58	35Z5GT	.38
3A5	.50	6AU4GT	.64	6SA7	.47	7X7	.64	39/44	.25
3AL5	.52	6AU5GT	.60	6SB7Y	.75	7Y4	.34	50A5	.47
3AU6	.52	6AU6	.42	6SC7	.47	7Z4	.39	50D5	.47
3BZ6	.57	6AU8	.79	6SQ7	.40	12A4	.59	50C5	.47
3BC5	.57	6AV5GT	.64	6SH7	.42	12A6	.40	50L6GT	.44
3BN6	.57	6AV6	.38	6SJ7	.42	12A8S	.59	80	.39
3CB6	.57	6AW8	.89	6SK7	.49	12AQ5	.49	84/6Z4	.45
3Q4	.55	6AX4GT	.65	6SL7GT	.56	12AT6	.40	117L7GT	1.25
3Q5GT	.56	6AX5GT	.56	6SN7GT	.56	12AT7	.65	117N7GT	1.25
3S4	.46	6BA6	.46	6SQ7	.40	12AU6	.42	117P7GT	1.25
3V4	.55	6BC5	.49	6SS7	.40	12AU7	.58	117Z3	.36
4BQ7	.75	6BC8	.89	6T4	.95	12AV6	.41	117Z6GT	.61
4BZ7	.75	6BD5GT	.52	6T8	.67	12AV7	.66		

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Generates greater energy than famed B2M. 2½x1¾x½" plug-in type; in handy case. **$2.88**

TRANSISTOR PORTABLE RADIO KIT with speaker No experience necessary! Famous make, with powerful Hi-Q ferrite antenna, diode det., 2 transistor ampl. stages, 4" spkr. 7½x5x2½" styrene case. For broadcast band. Instructions, diagrams, pictorials, all parts. 9V Battery, 69¢ extra. **$12.94**

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Uses famed plug-in SUPER SOLAR BATTERY . . . the only such kit usable day & night. NEVER WEARS OUT! No bulky ant. needed. All parts, sub/mini transistor, 3x2x1½" case, instructions. (Use with our Super-Powered Phone for best results.) Ship. wt. 1 lb. **$5.98**

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by digging around in the junk box and finding as many different resistor values as possible between 10,000 and 250,000 ohms. If you are missing any essential values, they can be made up by series or parallel combinations of available resistors.

To calibrate the ohms scale, simply place the known resistance between the common and ohms lead of the neon tester and adjust *R1* until *NE1* just begins to glow. Mark this point on the scale with the resistance value of the resistor. Continue the procedure until sufficient resistance points have been obtained.

Finishing Touches. Remove the pencil-calibrated scale from the neon tester. Now, simply multiply the a.c. scale by 1.41, and you can mark in the d.c. voltage calibration. For example, the a.c. voltage calibration of 100 volts would correspond to the d.c. calibration point of 141 volts. The reason for this becomes apparent when we realize that an r.m.s. a.c. voltage of 100 volts, as read on any meter, has a peak value of 141 volts. Since the neon lamp in the tester responds to the peak voltage applied, a d.c. voltage (which of course has a peak voltage corresponding to its average value) will read 1.41 times the a.c. voltage.

Then go over the pencil-calibrated scale with the more permanent India ink. The surface of the scale can be coated with polystyrene Q dope to give it a hard glossy finish. If the lettering is carefully done, the results will look quite professional.

The neon tester is now ready for operation. Always remember, when you use it, to adjust *R1* from the unlit neon position to the point where the neon lights. —30—

Off-the-Air Recording

(*Continued from page* 70)

The output of the tuner is usually a low-impedance line—just what you need for plugging into a tape machine. There are two main connecting methods. The choice between them depends on whether or not the preamplifier of your hi-fi has a "tape out" connection.

If there is no "tape out" on your preamp, you must unplug your tuner from the preamp and plug it into the tape machine, as as shown on page 69. If you're in luck, your tape recorder has a "monitor" jack. This jack enables you to take the signal that's being taped and feed it back into your amplifier or preamp so that you can hear the program as you record it.

If your recorder has no "monitor" output,

The ALL NEW "20-POUNDER" MYSTERY PACKAGE
of ELECTRONIC PARTS
Worth $40.00
OUR PRICE ONLY
$3.95
It's Another THRILLING HERSHEL SURPRISE. 20 pounds of BRAND NEW usable Govt. Surplus. Perfect gift for Hams, etc.
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60 CARBON RESISTORS
60 MICA CONDENSERS
100 SET SCREWS
8 1N22 XTAL DIODES
50 Ceramic Condensers
25-Ft. Phono-Mike Cable
1 SELENIUM RECTIFIERS
50 RF CHOKES
200 ft. HOOK-UP WIRE
1 TRANS. 6.3V-110 Vac.
5 PILOT PANEL LITES
5 RADIO-PHONO CHASSIS
4 LOOP ANTENNAS (RAD)
1 Meter Rectifier 0-1MA.
1 6 V-30 Amp. SOLENOID
1 PHANTOM ANTENNA A-42
1 TELEGRAPH KEY
5 MICRO SWITCHES
75-Ft. 300 OHM TV LEAD-IN
6 6-Ft. ac. LINE CORDS with PLUG
5 RADIO NOISE FILTERS
25-Ft. RG-58/U COAXIAL CABLE with PLUGS
1 PIX TUBE BRIGHTENER
3 CONDENSERS (500 MMFD 20,000 Volt)
100 Ft. of SPAGHETTI
10 GRAIN WHEAT LAMPS
BUTTERFLY CONDENSERS
YOUR CHOICE
$4.95
These units make the finest tuners for Ultra-high frequency transmitters, receivers, frequency meters, and oscillators.

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(compiled by the editors of *Radio & TV News*)

Authoritative, comprehensive 148-page guide to hi-fi construction, maintenance and equipment . . . compiled by top authorities in the field. Includes complete instructions and plans for setting up your own system—covers preamps, equalizers, amplifiers, tape recorders, speakers, enclosures and stereophonic sound.

Partial Contents

- Why's and wherefore's of room acoustics, speakers, enclosures.
- How to buy and install preamps, equalizers, tone controls.
- Do's and don't's of amplifiers.
- Latest techniques and ideas on stereophonic sound.
- Tape recording ideas and recorder guidance.
- Transistor hi-fi.
- All about speakers and enclosures.
- Building, servicing and improving hi-fi systems.

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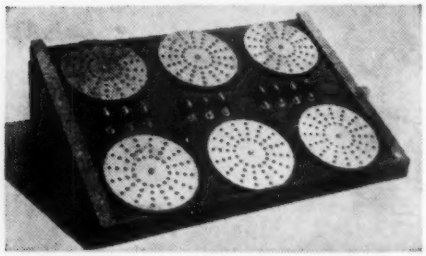

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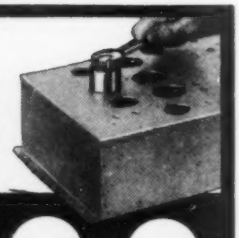

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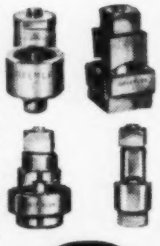

GREENLEE

you will not be able to listen to the radio program while it is going onto the tape. It is then more important than ever to have a warm-up period to set levels, and make a test run. After the program starts and you are plugged into the tape machine, you will hear nothing. But watching the volume indicator wiggle gives you assurance that the sounds you want are actually going onto the tape.

One way to improve this arrangement would be an extra output jack on your radio tuner, wired in parallel to the regular one, allowing you to send the radio signal simultaneously to the preamplifier and to the tape recorder. This extra output jack allows you to "monitor" the radio signal while recording—actually hear it as it goes on the tape.

If your preamplifier has a "tape out" connection, as well as a tape input, the whole job becomes simply one of throwing switches. (See last diagram on page 70.) The preamplifier "tape out" goes to the input of the tape machine. The output of the tape machine goes to "tape input" on the preamp, completing a head-to-toe loop. Now any program—radio, phonograph, or microphone—that comes into your preamp can be recorded with the greatest of ease and under excellent electrical conditions. And you can listen as you record.

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By following the simple rules outlined here, you can start your own collection of "memorable moments." —30—

1 A	2 G	3 C	■	4 P	■	5 J	A	6 C	7 K
■	8 R	A	9 C	E	■	A	■	10 H	I
11 W	A	F	E	R	■	12 S	13 L	A	T
14 O	Y	E	R	■	15 L	■	16 I	S	■
W	■	■	17 A	18 N	O	19 D	E	S	■
■	20 D	■	21 M	I	C	A	■	22 I	23 T
■	24 B	25 L	I	N	K	■	26 A	S	H
27 S	■	28 A	C	E	■	29 R	■	■	E
30 E	31 L	M	■	■	■	32 A	33 B	34 E	T
35 C	A	P	S	■	36 O	M	E	G	A

Solution to crossword puzzle appearing on page 112.

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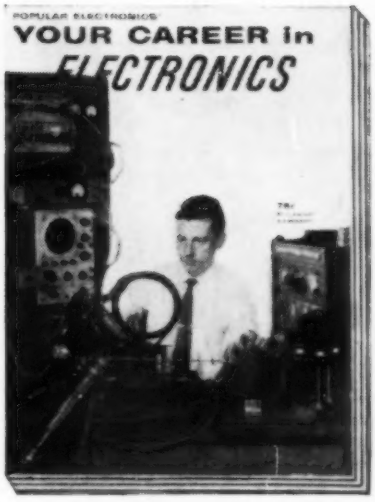

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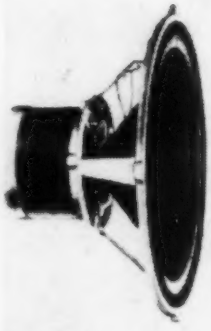

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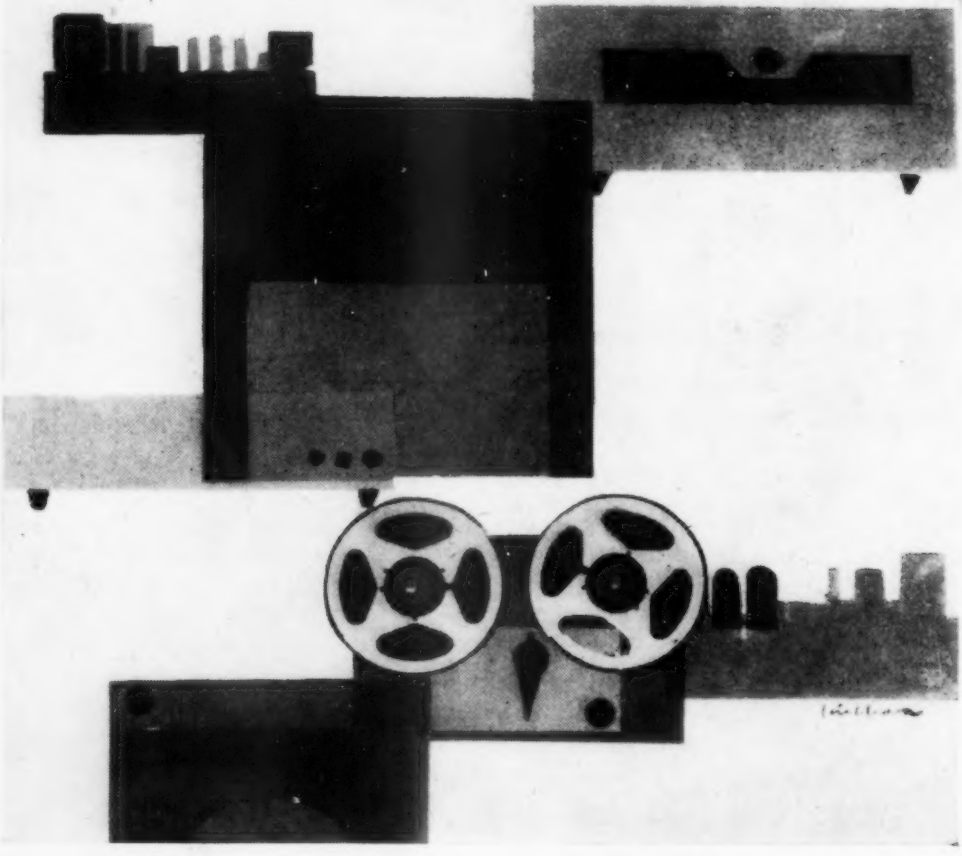

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After Class

(*Continued from page* 90)

spot of light in a specific area on the face of a cathode-ray tube, or a ferristor that is in one of its two stable conditions (see *After Class,* July 1957, p. 82). In any case, the stored *bits* of information must be readily accessible to the machine.

One of the most ingenious and successful methods of providing a computer with an infallible memory is the mercury delay line. A by-product of war-time radar, the mercury delay line is so remarkably reliable that it became an important part of UNIVAC I—which employs 126 channels of mercury that can remember 720,000 *bits* of information!

Mercury Memory. Figure 5 is a schematic representation of the structure of a mercury delay line. An electrical signal arrives at its input and acts upon a quartz crystal situated at the end of a tube full of liquid mercury. The signal voltage causes a piezoelectric distortion of the crystal, starting a ripple in the mercury which travels through the tube at sonic speed. When the ripple reaches the remote end of the tube—after a definite interval—it presses on a second quartz crystal, generating a voltage pulse exactly like the one which initiated the process. This pulse is amplified by a vacuum-tube amplifier and passed back to the first crystal to start the ripple on its way once again.

Thus, the *bit* of information goes around and around, and would continue forever if nothing were done to interrupt it; the machine has "memorized" the arrival of the pulse. At the desired moment, however, the machine may open an "and" or "or" circuit in the amplifier so that the pulse passes on to a succeeding response section of the computer. Or, if conditions call for it, the signal may be erased from the machine's memory merely by ordering the amplifier to stop amplifying at the instant the pulse reaches it.

Operation Figures. To provide some idea of the speeds and numbers involved in the operation of a mercury delay line, here are some figures. Velocity of sound in mercury at 65° is close to 1.5 millimeters per microsecond (1500 meters per second or a little under 5000 feet per second). The longest lines that can be conveniently handled are about five feet long and provide a delay of about 1/1000 second between the

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time of signal arrival at the input and the time it reaches the far end of the line.

The ripples in the mercury due to sequential pulses are not ordinarily spaced closer than 1 microsecond apart. But even with this spacing, 1000 ripples can be continuously circulating in a single tube, representing 1000 *bits* of stored information. The total memory of the machine is then limited only by the physical space available for the tubes.

Aptly enough, mercury memory is called *volatile*. Should the machine be closed down after a day's operation, whatever information is stored by the ripples is erased the moment power is removed. In UNIVAC II, the mercury tanks have been replaced by magnetic cores which have the advantages of compactness, insensitivity to temperature change, lower cost, and permanence of memory. -30-

Among the Novice Hams

(*Continued from page* 107)

point per second! This figure represents the unit of *quantity*, called the *coloumb*, which may be asked for in any amateur examination. Just remember: the unit of quantity is the coloumb.

Generating Current. Materials that allow current to flow through them are called *conductors*. Most metals are good conductors. Silver, copper, gold and aluminum, in the order named, are the most conductive of all the metals, although gold—for obvious reasons—doesn't see much use in the wiring of electronic equipment. The unit of *conductance* is the *mho*, of most importance here, because you may be asked to name it in your examination.

Besides *good* conductors, there are many materials—Nichrome wire and mixtures of carbon with other substances being examples—which resist passing current but will do so if "urged" enough. The unit of electrical resistance is the *ohm*. A high ohmage means a great resistance to the passage of current.

Finally, there are other materials—such as glass, dry air and paper, mica, polystyrene and porcelain—which offer such high resistance to the flow of current that they will melt, shatter or burn before giving in. They are called *insulators*.

The easiest way to start the electrons in a conductor into motion, thereby generating an electric current, is to connect it to a source of *electromotive force*—a force that moves electrons. Batteries create such electromotive force by chemical action, and generators create it by mechanical action. By either method, an excess of electrons is

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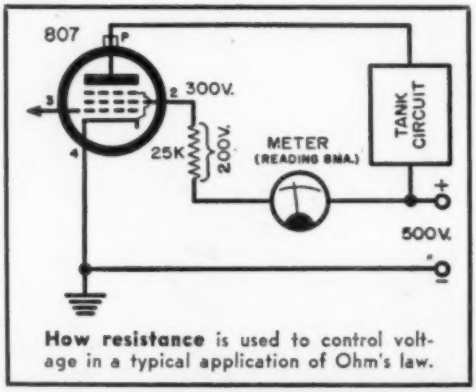
generated at the negative terminal (pole) and a deficiency of them is created at the positive terminal. In other words, a difference in electrical charge or *potential difference* is developed between the terminals. This potential difference is measured in *volts*. Or, put in another way, the unit of electromotive force is the *volt*.

Now, if a conductor is connected between these points of potential difference, the positive terminal will immediately start pulling electrons out of one end of the conductor, while the negative terminal pushes electrons into the other end, causing current to flow through the conductor at a speed of almost 186,000 miles per second.

Although electric current flows through a conductor at a tremendous speed, do not think that the individual electrons zip straight through it at that speed. Instead, their progress from atom to atom is more like that of visitors at a crowded exposition in a long building. They zig and zag from this exhibit to that, but the pressure of new people entering the building keeps pushing them forward until they are outside again.

Ohm's Law. The relationship between current, electromotive force, and resistance in any electronic circuit is described by *Ohm's law*, named after the man who discovered it. In words, Ohm's law states: *The amount of current in amperes that flows in any electronic circuit is equal to the electromotive force in volts divided by the resistance in ohms.* In elementary arithmetic, this relationship might be expressed as: amperes = volts ÷ ohms. Using algebraic symbols, it is written: $I = E/R$; where I= current in amperes, E = electromotive force (potential) in volts, and R = resistance in ohms.

Going a step further, a little reasoning will quickly show that if $I = E/R$, $I \times R$ or $E = IR$, and that $R = E/I$, with the letters retaining the same meanings as above. Thus, knowing Ohm's law and any two quantities of current, voltage and resistance, the third one is easily calculated.



How resistance is used to control voltage in a typical application of Ohm's law.

An example will show how Ohm's law is used to solve a practical problem. In a certain circuit, an 807 tube is designed to operate at a plate potential of 500 volts at a current of 100 milliamperes (0.1 ampere) and a screen potential of 300 volts at 8 ma. (0.008 amp.). Instead of using a separate power supply to furnish the screen grid power, we can use a resistor to reduce the 500 volts to the 300 volts required.

In order to calculate the amount of series resistance necessary, first subtract 300 volts from 500 volts to determine the amount the potential must be reduced—200 volts. Substitute this value and 0.008 amp. in the formula $R = E/I$ and solve for R: 200/0.008 = 25,000 ohms.

Power Formula. Obviously, forcing current through resistance consumes energy or power. This power is dissipated as heat. In an incandescent light bulb, for example, the power used to push current through its tungsten filament raises the filament temperature so high that it emits light.

The unit of electric power is the *watt*. It is easily calculated using the formula: $P = EI$; where P = power in watts, E = electromotive force (potential) in volts, and I = current in amperes. From Ohm's law, we know that $E = IR$. Therefore, the power formula may also be written: $P = I \times I \times R$; or simply $P = I^2R$.

With the aid of the power formula, we quickly see that a 25,000-ohm resistor carrying a current of 0.008 amp. must dissipate a power of 1.6 watts. To allow an adequate safety factor, a 3- to 5-watt resistor would normally be used. (A resistor's dissipation depends upon its mounting also.)

Conversion. Notice particularly that Ohm's law and the power formula give correct answers only when the values of current, voltage, and resistance are expressed in amperes, volts and ohms, respectively, in the formulas. This is very important, because the prefixes of *kilo* (1000) abbreviated K (kilo-ohm = kΩ = 100 ohms), *milli* (1/1000 or 0.001) abbreviated m (milliampere = ma. = 0.001 ampere), and *meg(a)* (1,000,000) abbreviated M (megohm = MΩ = 1,000,000 ohms) are often used in radio/electronic circuits, as well as in the FCC amateur examinations. So it is necessary to learn how to convert from one unit to another.

To change *kilo*-units to *units*, multiply the kilo-units by 1000: 25KΩ = 25,000 ohms. To change *units* to *kilo*-units, divide the units by 1000: 47,000 ohms = 47KΩ. To change *mega*-units to *units*, multiply the mega-units by 1,000,000: 4.7M = 4,700,000 ohms. To change *units* to *mega*-units, divide the units by 1,000,000: 250,000 ohms = 0.25MΩ (this could also be written as 250KΩ.) To change *milli*-units to *units*, di-

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vide the *milli*-units by 1000: 50 ma. = 0.050 amp. To change *units* to *milli*-units, multiply the units by 1000: 1.5 amp. = 1500 ma.

If you are with me so far, the most-missed questions in the Novice examination will be easy for you, and you are ready for next month's lesson.

News and Views

Pete, WN1NXB, has been putting Vermont on the air for the past few months by making 213 contacts in 13 states, Germany and Alaska. He transmits on a Johnson Adventurer — modified to use a 6146 tube — at 75 watts, feeding a Windom antenna, and he receives on a Heath AR-3. Pete reports that 90% of the stations he works need his card for WAS, but they are better at asking for his card than they are at sending theirs to him . . . **Stan, KN2UDX,** has had his license for seven months but has been on the air for only three months. He made 23 contacts in seven states, using a modified "all-wave" receiver and a home-built 6AG7-6L6 transmitter, running 30 watts. Recently, Stan figured out how to feed the output of the intermediate-frequency stages of his receiver through the i.f. amplifier of an old portable in the shack, thereby increasing selectivity and sensitivity about three to one . . . **Bud, KN5KAY,** thinks there should be more KN5 news in *News and Views*. In a month, he has made 173 contacts in 21 states, getting an answer to almost every call. Bud favors using abbreviations on the air, instead of spelling everything out.

Dick, KNØIJC, wasn't getting out too well

Aids to Learning Code

Two items of interest to those wishing to learn the radio code are the booklet, "Mastering the Morse Code," by Martin Schwartz, and a clever new code-sending device called "E-Z-Code." In its 32 pages, "Mastering the Morse Code" tells exactly how to do that. If you follow the instructions and practice, you can't miss. It sells for 50 cents a copy and is available from American Electronics Co., 1203-05 Bryant Ave., New York 59, and from amateur supply houses.

Theoretically anyone should be able to "send" perfect Morse code on the new "E-Z-Code" device ten minutes after opening the box. Cleverly constructed, it has the dots and dashes of the Morse alphabet printed in copper on an insulated board. And by simply sliding the "magic pencil" provided down one of the vertical slots, you will be able to hear the corresponding letter or number "automatically" sent on the built-in buzzer. A flashlight bulb and standard-type telegraph key are provided as part of the instrument to enable conventional sending practice. "E-Z-Code" is produced by the Aerovox Co., New Bedford, Mass., and is available from Aerovox distributors. Suggested retail price is $12.95.

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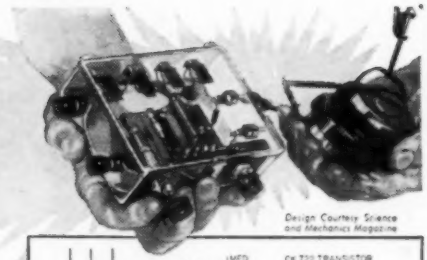

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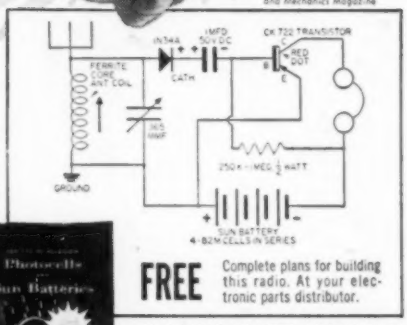

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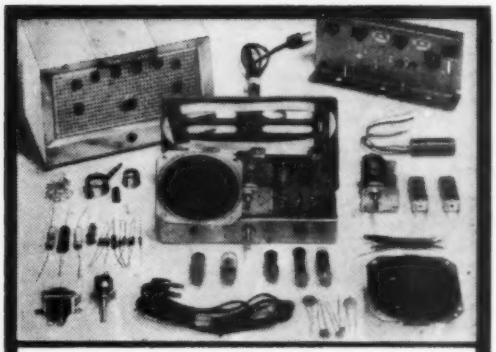

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until KØARU helped solve his antenna problems. Now his "sandwich box" transmitter, running 11 watts, folded dipole, and his Hallicrafters S-38 receiver are both doing well. Without a Call Book, it is quite a task, but Dick tries to QSL his contacts 100% . . . The heavy interference in the evenings makes it difficult for **Joe, KN4OMW,** to make many contacts then, but in the daytime his homebrew transmitter does fine. It uses a 6V6 at 15 watts input to a doublet antenna and has racked up 28 states. A National NC-98 does the receiving . . . **Ron, KN4LWZ,** uses a home-built 25-watter and a Scott 215 receiver on 40 meters. In 2½ months, he has worked 22 states, Puerto Rico, and half a dozen Cuban stations . . . **Tex, KN2VAB,** works 15 and 40 meters with a Heath AT-1 and a converted ARC-5 transmitter, combined with a Hallicrafters SX-28 receiver. He has hooked up with 22 states and two Canadians.

On July 8, 1957, **W6NLZ,** Palos Verdes Estates, Calif., and **KH6UK,** Oahu, Hawaii, contacted each other on 144 mc. after nine months of trying. The 2600 miles covered is over *twice the previous 2-meter DX record* . . . **Roger, KN4MZN/K4MNZ,** has made 80 contacts in 23 states—12 confirmed—in 2½ months of trying. He receives on a Hammerlund HQ-100 and transmits on a Johnson Adventurer aided by a 40-meter doublet and a 15-meter ground-plane antenna. His best DX is the west coast, Cuba, and Puerto Rico. Roger offers to help prospective amateurs get their licenses . . . **John, KN2VMT,** excites

Want to Sked England?

Because of the tremendous interest created by the offer of **Eric, G3JEA,** to schedule Novices on 7 mc. (*News and Views*, page 120, POPULAR ELECTRONICS, July, 1957), he will operate between 7142 and 7150 kc. on the following schedule until next April: 0000 to 0200 GMT (7:00 to 9:00 p.m., EST) for east coast Novices and 0400 to 0700 GMT for midwestern and western Novices.

G3JEA will call "CQ WN" at 0000, 0010, etc., at a speed of 8 wpm and will tune 7150 to 7200 kc. for replies. If more than one Novice is heard calling, each will be acknowledged and then worked one at a time. Preference will be given Novices who have previously written for schedules. To allow many Novices to be worked, contacts will normally be short. Upon conclusion of a contact, G3JEA will send "QRZ?" three times and listen for further calls. If none are heard, he will wait until the start of the next ten-minute period, when he will again call "CQ WN." Call G3JEA at the speed you wish to be answered, whether it be 2 wpm or 45 wpm.

All contacts will be confirmed by airmailed QSL cards. Send your cards to: J. Eric Alban, G3JEA, 85 Inverness Terrace, London, W2, England.

Details on G3JEA's station will appear in next month's *News and Views*.

a doublet antenna with a home-built, 10-watt transmitter and receives on a Heath AR-3. *His* best DX has been California several times. Coast to coast on ten watts is worth talking about!

Contributors to News and Views: **Pete Ruby, WN1NXB,** Church St., Poultney, Vt.; **Stan Daniels, KN2UDX,** 43 Clendenny Ave., Jersey City, N. J.; **James "Bud" Richardson, KN5KAY,** Wichita Falls, Texas; **Dick Kragh, KNØIJC,** 5642 North 28th Ave., Omaha 11, Nebr.; **Joe Knight, KN4OMW,** Box 182, RFD 4, Hamilton, Ala.; **Ron Hines, KN4LWZ,** 14300 N.W. 16 Court, Miami, Fla.; **Tex Birnholz, KN2VAB,** 634 High St., Newark 2, N. J.; **Roger Klingaman, KN4MZN,** 851 N.E. 128 St., N. Miami, Fla.; **John Brinkima, KN2VMT,** Ramapo Vaccy Road, Oakland, N. J.

From time to time, I receive queries about how to get an item in *News and Views*. The answer is simple. Mail your items and pictures to me, and I'll do the rest. If lack of space prevents me from printing your first contribution, try again, please. Until next month, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 84)

by *RFE* is obtained by continually monitoring radio stations located behind the Iron Curtain and, especially, the smaller stations that transmit mainly to regional areas within their own boundaries. As a result, *RFE* is able to learn a great deal about the internal situation of the various countries and, by reading between the lines, the reaction of the people. Over 30 Iron Curtain stations are monitored on a regular basis and several others by spot checks.

Actual *RFE* broadcasting time averages around 21 hours a day for Poland, Hungary, Czechoslovakia, less for Bulgaria and Rumania. During times of crises, it may be necessary to extend the broadcasting time. *RFE* has run for 24 hours a day over a period of several days upon occasion.

The first ten minutes of each hour is devoted to the news and these programs are "live;" the other programs normally are taped before broadcasting. One interesting feature is a "saturation broadcast," aired daily at midnight, which is achieved by beaming every transmitter on one particular target area.

Programs are broadcast over a total of 22 transmitters located in Germany and Portugal. During a normal day, programs to any one target area are sent on several frequencies (as many as seven frequencies may be used at any one time). This multiple channeling, coupled with the "saturation broadcast," has proven to be highly successful, and the programs are usually received in the target areas with little or no diffi-

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culty. In fact, over 1000 jamming stations are utilized by the opposition in an attempt to overcome the *RFE* broadcasts.

In next month's column, we'll have some interesting facts about the transmitters and antenna systems of *Radio Free Europe*.

Current Reports

The following is a compilation of the latest reports received. We regret that we cannot use everyone's report due to lack of available space. All times shown are Eastern Standard Time, using the 24-hour system. At the time of compilation, all reports are correct. Please keep in mind that stations often change frequencies and/or schedules with little advance notice.

Argentina—LRA, Buenos Aires, 9690 kc., has changed its slogan from *Radio Del Estado* to *Radio Nacional*. This is often heard evenings at 1930-2200 with classical music and Spanish language. (*11, 88*)

Austria—A letter from *Osterreichischer Rundfunk*, Vienna, states that there is no special N.A. service and no boost of their xmtr's power is intended. Their sked is as follows: OE135, 11,775 kc., 1205-1245; OEI24, 11,785 kc., 2330-1200 and 1300-1900; and OEI36, 11,935 kc., 2130-2300. The three stations are using only 200 watts power. There is, however, a pgm beamed to S.A. on 25,615 kc. at 0200-0900. This xmtr runs 20 kw. (*GH*)

Belgium—*World Fair Radio*, Brussels, is heard with Dutch and French at 1700-1730 and Eng. to 1800 on Mondays, Tuesdays, Thursdays and Fridays and at 1930 on Sundays, Tuesdays, Thursdays and Fridays in an xmsn beamed to N.A. and S.A. On Saturdays, the special Eng. session continues to be noted at 1815-2000. Frequencies used are 15,335 and 11,850 kc., and a relay from Leopoldville, Belgian Congo, on 9655 kc. (*61*)

Bolivia—CP38, La Paz, 9433 kc., is now on this frequency, having previously moved from 9440 and 9505 kc. It is noted from 2020 with organ music. The IS is a four-note chime and s/off is at 2130 after the playing of "Onward Christian Soldiers." (*166*)

Brazil—*R. Vittoria*, location not yet known, 5055 kc., is being heard at 1800-1900 with popular music. Another new station, *Emissora Catharinenses da R. Guaruja, Florianopolis* (?), is on 5975 kc. with s/off at 2055A. (*TO*)

R. Globo, ZYZ26, 6035 kc., comes through in Portuguese, Spanish, and Eng. at 0400-2200. This one is listed for 10 kw. (*27*)

PRN9, Rio de Janeiro, can be heard on 9293 kc. at 2015 and at times from 1730 with music and Portuguese language. (*166*)

R. Diario da Munha, 9675 kc., Florianopolis, was tuned at 2030-2100 with dance music . (*23*)

Soc. Radiofusao Caucique de Sorocaba, Sorocaba, was logged at 2100 with heavy QRM from ships and another broadcast station, possibly H13C, Dominican Republic. (*91*)

Bulgaria—*R. Sofia* has two xmsns to N.A. daily at 2000-2030 and 2300-2330 on 9700 kc. A mailbag program is presented on the first Thursday of each month. (*JE, PE, HA*)

Burma—Burma B/C Service, XYZ, Rangoon, is being tuned on 11,764 and 9543 kc. with Eng. at 0915-1015, news from 1000. Re-

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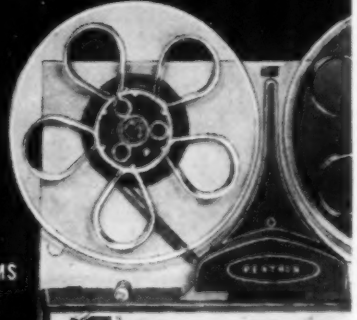

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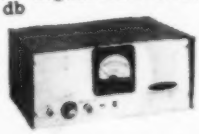

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ports go to *Voice of Burma*, No. 28 Windermere Crescent, Rangoon, Burma. (*11, 104*)

Chile—A station rarely reported is CE610, 6100 kc., Santiago, heard from 2030 with ID and Spanish music. TGOA on 6102 kc. provided QRM. (*166*)

Costa Rica—TIDCR, San Jose, 9618 kc., has an Eng. period at 2305-2330 with news at 2325. Spanish picks up at 2330. Power is 3 kw. (*237, 289*)

Cuba—*This is Pirate Radio Station—Radio Free Cuba* has been heard intermittently on 7043 kc. and was last noted at 2120. It is mobile, in a truck. (*150*)

Ecuador—*Radio San Miguel de Ibarra*, Calle Maldonado 40, Apartado Postal 181, Ibarra, is scheduled at 1000-1330 and 1700-2215 with 460 watts. (*TO*)

HC2RL, Guayaquil, 6635 kc., was noted at 2017 with U. S. anthem, "God Bless America" and others, in Spanish. (*166*)

Egypt—Cairo is excellent with French news at 1415, Eng. news at 1500-1510 on 12,025 kc. They announced that a new outlet on 17,915 kc. would be used in the next xmsn to Europe in an Eng. session. (*166, 208*)

Another Cairo outlet on 9795 kc. is well heard in Portuguese at 1830-1900 and Spanish at 1900-1930 to Latin America. (*211*)

England—A reported new frequency for the BBC is 15,340 kc., noted at 2342-2349 with dictation-speed news and a talk. (*WP*)

French Equatorial Africa—Possibly a new outlet for Brazzaville is 17,885 kc., heard in a language period at 0950. (*26*)

French Guinea—*R. Conakry*, Conakry, is now tuned on 3376 kc. to 1630 daily, dual to 4910 and 6155 kc. It is easily recognized by *Ici Conakry* ID. (*166*)

Ghana—Accra has replaced 9615 kc. with 9640 kc. and also uses 4915 and 3366 kc. in parallel. (*166*)

Guatemala—TGCB, Guatemala City, 6080.5 kc., was noted with the marimba and Spanish music at 2020-2030. Peru on 6082 kc. provided the QRM. (*166*)

Haiti—4VC, *R. Commerce*, Port-au-Prince, has apparently moved from 9485 kc. to 9543 kc. It is being noted at 1615 with pop music and at 1700 with a pgm called "Glimpses of Haiti." (*23, 166*)

Iceland—TFJ, *Utvarp Reykjavik*, Reykjavik, 12,175 kc., has replaced the 1115-1130 Sunday xmsn with a new one, again on Sundays only at 1500-1600. (*10, 11, 27*)

India—VUC, Calcutta, is being heard on 9530 kc., weakly, at 0630 with Indian music and language. (*166*)

All-India Radio, Delhi, is excellent in an xmsn to East and Southeast Asia at 0830-0930 on 17,840 kc., with Eng. from 0835. Sweden QRM's Delhi from 0900. (*104*)

Italy—Eng. xmsns from *Radio Roma* are as follows: 0400-0430 on 21,560, 17,800, and 15,325 kc.; 1035-1055 on 21,560 and 17, 770 kc.; 1915-1935 on 15,400 and 11,905 kc.; and 2125-2145 on 11,905 and 9575 kc. (*61*)

Japan—*R. Japan*, Tokyo, is scheduled at 1800-1900 on 17,825 and 15,325 kc. to Eastern N. A. This full hour replaces two previous half-hour segments. (*212*)

Kenya—ZHW6, Kisumu, is reported testing

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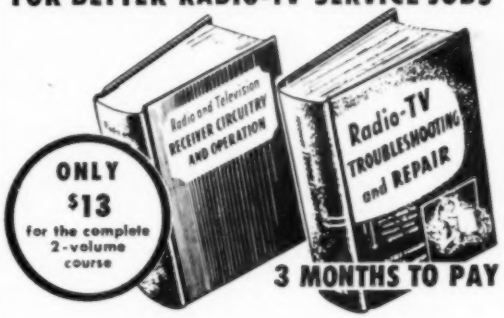
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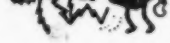

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on 4964 and 4985 kc. It previously operated on 4943 kc. Listeners in Sweden are hearing this one until 2030-close. Sked is believed to be 2230-2330 and 1100-1530. Power is given as 500 watts. (*TO*)

Liberia—ELWA, Monrovia, is beamed to N.A. on 15,200 and 21,535 kc. at 1800-1930, with a repeat on 9650 and 21,535 kc. at 2000-2130. (*RB, FW*)

New Zealand—ZL14, Wellington, 17,820 kc., is noted daily with programs relayed from the Home Service. Music is tuned at 1830-1930, news to 1935, weather at 1935, then more programs for regional listeners. (*61*)

Norway—*Radio Norway*, Oslo, is heard in the Far East beam at 0600-0700 on 21,670, 17,825, 15,175, and 11,735 kc., with opening and closing ID in Eng. and Norwegian; remainder of program is in Norwegian. (*61*)

Novaya Zemlya — The elusive *Voice of Novaya Zemlya* has again been heard on 6195 kc. at 0225 with Eng. news. Signals are weak but clear. Has anyone else heard it? (*286*)

SHORT-WAVE ABBREVIATIONS

A—Approximate frequency
BBC—British Broadcasting Corporation
Eng.—English
ID—Identity, identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
N.A.—North America(n)
pgm—Program
QRM—Station interference
R.—Radio
S.A.—South America(n)
sked—Schedule
s/off—Sign-off
xmsn—Transmission from station
xmtr—Transmitter used by station

Pakistan—Karachi broadcasts in Eng. on 11,674 and 15,245 kc. at 1315-1400 (news at 1330) to Turkey and at 1415-1500 to England. The outlet on 17,740 kc. has an Urdu language program to S.E. Asia at 1930, following an Eng. ID. (*61, 289*)

Paraguay — ZPA5, Encarnacion, has been tuned on 11,990 kc. from 1800 ID with American and Spanish recordings. (*166*)

Peru—According to *World Radio Handbook*, *R. America* carries Eng. on 9360 kc. Confirming this, it has been heard at 0800-0900 in Eng., mostly with music. The signal is weak and there is QRM from *R. Progresso*. (*208*)

OAX1D, Chiclayo, is being noted on 3379 kc. at 0040 with Spanish music and language. This may be a new station. (*166*)

OAX4J, *R. La Cronica*, Lima, 9390 kc., is noted late evenings with music and many commercials (up to as many as five commercials in a row). (*WP*)

Philippines—The Far East B/C Co., Manila, DZ16, 17,805 kc., has been heard at 0130 with an Eng. religious program, at 1130-1200 with a similar program in Russian, Eng. ID at 1205-close, and again at 1700 with a program in Japanese. The latter is a rare catch for this time of day. (*39, 61*)

DZH9, Manila, 15,300 kc., can be heard in the east from 0900 to fade-out at 0945-1000 with religious programs. This is dual with 11,850 and 9730 kc. (*59*)

Rarely heard DYH2, 6140 kc., Cebu City,

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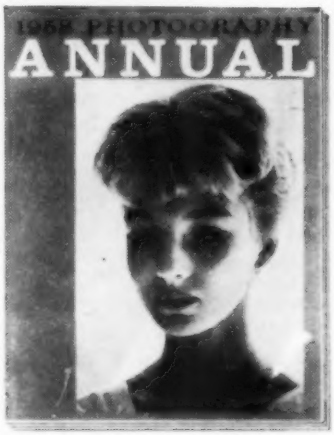

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has been caught in Sweden opening at 1600. This station frequently carries baseball games. (*TO*)

Portugal — CSA66, Lisbon, 17,895 kc., is heard with fine signals with *Emissora Nacional* programs at 1245-2000; all Portuguese and a lot of excellent music. (*61*)

Spanish Guinea — *R. Ecutorial*, Bata, is noted in the east as early as 1530 with Spanish news on 7786 kc. This one closes at 1700. The 8800-kc. outlet was dropped some time ago. (*166*)

Sudan — *R. Omdurman* has moved from 5000 kc. to 4975A kc. to avoid QRM from Kuwait. (*TO*)

Tangier — *Norea Radio* is reported to be operating on 9335 kc. in Norwegian at 1730-1800 daily. Address: Gransen 19, Oslo, Norway. (*TO*)

DUX Radio (via *Radio Tangier International*) is heard on 9333 kc. at 1510 in French with popular instrumentals, at 1620 with a Spanish religious program. Eng. is broadcast at 1400. (*166*)

Thailand—HSK9, Bangkok, 11,670 kc., has English news at 0600, pop and Oriental music to 0630, Malayan after 0630. (*226*)

Turkey—The N.A. Service of *Radio Ankara* can now be heard on 7285 and 9465 kc. at 1815-1845. They QSL promptly with a nice card. (*226, 277*)

USA—For listeners in the Latin American Countries, WGEO, Schenectady, 9530 kc., has "Report From The USA" at 1930-1940, "Listener's Club" to 2000, "Music USA" at 2000-2200. (*67*)

USSR — A weak station, almost certainly Moscow, is being heard on 8760 kc. at 0830-0900 in language. (*JY*)

Unidentified—A station has been noted on 11,590A kc. at 1900-2000 with singing and native music. Announcements seem to be in French. (*82*)

—30—

SHORT-WAVE CONTRIBUTORS

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VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 • **A.C. VOLTS:** 0 to 15/30/150/300/1,500/ Volts • **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 1.5/15 Amperes • **RESISTANCE:** 0 to 1,000/ 00 Ohms 0 to 10 Megohms • **CAPACITY:** to 1 Mfd. 1 to 50 Mfd. (Good-Bad-scale for checking quality of electrolytic condensers.) • **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms • **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries • **DECIBELS:** —6 to +18, +14 to +38, +34 to +58.

Complete with test leads **$28.40** Net

perior's New Model TV-40

PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

s all magnetically deflected picture tubes 7 inch to 30 inch types.
s for quality by the well established emis- ethod. All readings on "Good-Bad" scale. s for inter-element shorts and leakages up egohms.
for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube case (Ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only **$15.85** Net

Model 770-A
Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

Model 670-A
Terms: $7.40 after 10 day trial then $3.50 per month for 6 months.

Model TV-40
Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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Dept. D-382, 3849 Tenth Ave., New York 34, N. Y.

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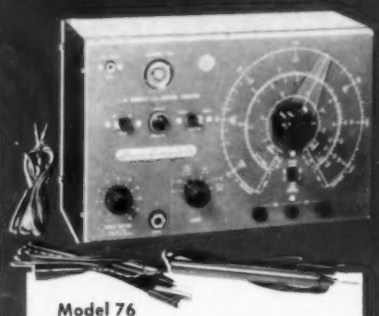
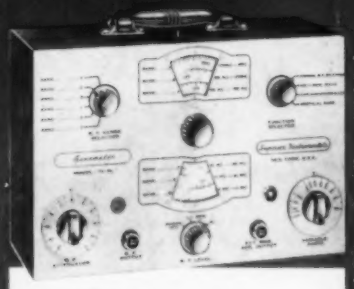


Model 76
Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.



Model TV-50
Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

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Superior's New Model **76**

IT'S A **CONDENSER BRIDGE**
IT'S A **RESISTANCE BRIDGE**
IT'S A **SIGNAL TESTER**
IT'S A **TV ANTENNA TESTER**

Specifications

CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

SIGNAL TRACER SECTION
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, loca signal loss in R.F. and Audio stages, calize faulty stages, locate distortion a hum, etc.

TV ANTENNA TESTER SECTIO
Loss of sync., snow and instability a only a few of the faults which may due to a break in the antenna, so w not check the TV antenna first? Loca a break in any TV antenna and measu the location of the break in feet fr the set terminals.

Complete with R.F. and A.F. probes and test leads **$26**

Superior's New Model TV-50 **GENOMETER**

7 Signal Generators in One!

- **R.F. Signal Generator for A.M.**
- **R.F. Signal Generator for F.M.**
- **Audio Frequency Generator**
- **Marker Generator**
- **Bar Generator**
- **Color Dot Pattern Generator**
- **Cross Hatch Generator**

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

BAR GENERATOR: Pattern consists o to 16 horizontal bars or 7 to 20 verti bars.

DOT PATTERN GENERATOR (FOR COLO TV): The Dot Pattern projected on a color TV Receiver tube by the Model T 50 will enable you to adjust for prop color convergence.

CROSS HATCH GENERATOR: The patt consists of non-shifting horizontal a vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads **$47**

TRY FOR 10 DAYS

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